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Human Dimensions of Habitat Loss in the Plains and Prairie Potholes Ecoregion

Lily A. Sweikert
South Dakota State University

HUMAN DIMENSIONS OF HABITAT LOSS IN THE PLAINS AND PRAIRIE POTHOLES ECOREGION

BY

LILY A. SWEIKERT

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LILY A. SWEIKERT

This dissertation is approved as a creditable and independent investigation by a candidate for the Doctor of Philosophy in Wildlife and Fisheries Sciences degree and is acceptable for meeting the dissertation requirements for this degree. Acceptance of this dissertation does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Larry Gigliotti, Ph.D. Date

Dissertation Advisor

Michele Dudash, Ph.D. Date

Head, Department of Natural Resource Management

Dean, Graduate School Date

This dissertation is dedicated to all living beings who call the Great Plains home.

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ABSTRACT

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The Plains and Prairie Potholes Ecoregion (PPPE), is located in the north-central contiguous United States and is one of the most imperiled grassland regions in the world. Most of the region is privately owned and used for the production of agricultural commodities. In addition to its direct benefits to humanity, the PPPE provides multiple ecosystem services including, soil and water quality improvements, carbon sequestration, weather amelioration, and wildlife habitat. Recent increases in expansion of row crop agriculture concerns conservation practitioners about the long-term integrity of the PPPE. Conservation practitioners are looking to improve their private landowner conservation initiatives in the region. I collaborated with the state agencies of Minnesota, North Dakota, and South Dakota to survey private landowners about their demographics, attitudes, motivations, values, and behaviors related to land use (cover letters and questionnaires are provided in the Appendix). This dissertation aims to provide an understanding of private landowners' land use decisions. First, I provide background information on the ecology, land ownership, economy, land use, and status of conservation efforts in the region. I also review literature about agriculture producers' attitudes, values, and practices related to conservation, and scales developed to measure environmental cognitive factors and I state my dissertation objectives (Chapter 1). Second, I describe the process used to develop the Land Use Value (LUV) scale, a

measurement instrument to understand the values farmers and ranchers have for their land, with respect to conservation (Chapter 2). Reliability and validity testing of the LUV scale indicated it successfully predicted attitudes, motivations, and behaviors related to conservation. Third, I used the LUV scale to identify landowners' LUV types and evaluate choices of production practices and conservation behaviors, to improve the effectiveness of conservation initiatives (Chapter 3). The results showed each LUV type had distinguishing characteristics that can be used to evaluate and align grassland conservation practices, policy, and messaging. Fourth, I investigated the role of Farm Bill Conservation Programs in conserving grassland habitat in the PPPE (Chapter 4). I found unifying characteristics among participants and nonparticipants of Farm Bill Conservation Programs that can be used to direct recruitment efforts, but found a negative relationship between participants and having land in grass that needs to be further investigated. Fifth, I conclude with a review of the challenges facing the PPPE ecosystems and private landowners, knowledge gained from this research, and encourage conservation professionals and decision makers to use the information presented here to find new ways to conserve the ecosystems they cherish (Chapter 5). Overall, this study provides conservation practitioners with useful information about farmers and ranchers in the PPPE that can be used to improve conservation efforts.

CHAPTER 1: INTRODUCTION

1. Background Information

The Great Plains has been characterized as a vast expanse of treeless land, almost entirely covered with grass, sitting in the middle of the contiguous United States, that stretches from Canada to Mexico and the foothills of the Rocky Mountains to western Wisconsin and Indiana (Samson & Knopf 1994). These grasslands were one of the largest ecosystems in North America. When Europeans first settled the Midwest the Great Plains were estimated to have covered about 4,349,598 mi^2 (7 million km^2) (Samson et al. 2004; Lauenroth et al. 1999). From east to west, grass height decreases with corresponding amounts of precipitation, resulting in tall-, mixed-, and short-grass prairie (Symstad and Jonas 2011). Increasing mean annual temperature from north to south results in a corresponding change from cool-season to warm-season grasses (Lauenroth et al. 1999).

The Plains and Prairie Potholes Ecoregion (PPPE), as defined by the U.S. Fish and Wildlife Service (PPPLCC n.d.), is a grassland and wetland ecosystem in the northern Great Plains. The prairie potholes are characterized by numerous small wetlands formed by receding and melting glaciers over 10,000 years ago (Higgins et al. 2002). The PPPE region is situated in part of Iowa, Minnesota, Montana, Nebraska, South Dakota, Wyoming, and all of North Dakota, as well as part of Canada, however, for the purpose of the research presented here, I focus on the states of Iowa, Minnesota, Montana, North Dakota, and South Dakota (PPPLCC n.d.). The PPPE lies within the northwestern mixed grassland, northern mixed grassland, northern tall grassland, and central tall grassland

terrestrial ecoregions (Ricketts et al. 1999). The PPPE also lies within the English-Winnipeg Lakes, Upper Missouri, Middle Missouri, and Mississippi freshwater ecoregions (Abell et al. 2000).

The Great Plains evolved in the presence of large-scale disturbances such as fire, large herds of ungulates, and prairie dogs (Truett 2003, Anderson 2006). Before European settlement, the Great Plains rivaled the African Serengeti, in terms of wildlife, teeming with bison (*Bison bison),* antelope (*Antilocapra Americana*), and massive prairie dog colonies (*Cynomys*) (Truett et al. 2001). While disturbances no longer exist at historic scales, fire, grazing by cattle and bison, and small remaining patches of prairie dogs help maintain unique biodiverse ecosystems (Hart 2001, Symstad and Jonas 2011). In addition to those grazing herbivores, today's grasslands support the largest and most diverse populations of breeding birds such as waterfowl, shorebirds, waterbirds, and grassland songbirds in North America (Stephens et al. 2008).

The continued existence of the PPPE ecosystems depend on conservation of the grassland's biodiversity (Hooper et al. 2005). Ecosystems are complex interconnected systems whose processes are driven from the top down, bottom up, and laterally (Miller et al. 2001). An extensive body of research supports the idea that a large pool of species is required to sustain the assembly and functioning of ecosystems (Loreau et al. 2001). The functional properties of the organisms that constitute an ecosystem, as well as their distribution and abundance, in combination with abiotic factors such as climate, dictate the ecosystem's functioning (Hooper et al. 2005). While it is not clear whether this

dependence on diversity is due to the need for a few key species or the need for a rich assortment of complementary species (Loreau et al. 2001), undoubtedly, the loss of habitat will result in changes in biodiversity that will alter ecosystem processes and could change the resilience of an ecosystem to environmental events such as disease, drought, and fire (Chapin et al. 2000).

Not only is the correct functioning of ecosystems important for the ecosystems themselves, but they also provide services crucial to the survival of humanity (Hooper et al. 2005). Ecosystem services are economic benefits provided by nature (McCauley 2006). The PPPE ecosystems provide both direct and indirect benefits to humans (Sala and Paruelo 1997). The direct benefits of grasslands are obvious in how humans currently use the region to produce agricultural commodities and hunt and fish. The primary productive uses of grasslands are grazing of livestock or conversion to croplands (Sala and Paruelo 1997). Indeed, the majority of human food is derived from intact and converted grasslands. Indirect benefits often go unrecognized and include improvement of water quality, carbon sequestration, amelioration of weather, and conservation of soils (Sala and Paruelo 1997). While the idea of ecosystem services is useful for communicating the value of biodiversity in today's dominant economic paradigm, focusing too heavily on the provision of ecosystem services alone could jeopardize ecosystem function by overlooking important aspects of the ecosystem, as explained above (Gómez-Baggethun & Ruiz-Pérez 2011; Kellert 1984). Regardless of the method used to value the PPPE it is clear that conserving it is important.

In the PPPE, as in the rest of the United States, there is no comprehensive source for the amount of land that is privately owned. However, for the states of Iowa, Minnesota, Montana, North Dakota, and South Dakota in the PPPE, subtracting the amount of land owned by the federal and state governments and Native American tribes from the total acreage area of each state, reported to me by personnel within each state government, approximately 82% of the land is privately owned (Coughlin 2014, Fritzell 2014, Hoch 2014, Gude 2014, Kading 2017). In comparison to the rest of the country, the federal government owns about 640 million acres, or 28% of the land (Vincent et al. 2014). Another source estimates combined federal and state land ownership at 35% (Natural Resources Council of Maine 2000). These estimates suggest a range of privately owned land across the nation from 65% to 72%. Therefore, there is 10-17% more privately owned land in the states of the PPPE than the average for the rest of the country. Landownership has a significant impact on conservation with about half of all endangered and threatened species found exclusively on private land (Stein et al. 2008) and 91% of endangered and threatened species are dependent on private land for habitat (Wilcove et al. 1996). This demonstrates the clear and present need to establish good working relationships between conservation professionals and private landowners in the PPPE, to be successful in achieving large-scale conservation goals.

The majority of land in the five states of Iowa, Minnesota, Montana, North Dakota, and South Dakota is considered *land in farms*, which "consists of agricultural land used for crops, pasture or grazing. Also included is woodland and wasteland… provided it was part of the farm operator's total operation [and] includes acres in the

Conservation Reserve, Wetlands Reserve Programs, or other government programs" (U.S. Census Bureau 2012, U.S. Department of Agriculture and National Agricultural Statistics Service 2013). The average percent of *land in farms* in the above five states is 74%. In comparison to the nation as a whole, only 47% of the country's land is *in farms*. This demonstrates the presence of a large agricultural industry in the PPPE.

From 1950-2000, the total cropland in the Great Plains changed little, decline by slightly less than 1% (Brown et al. 2005). However, from 2006-2012, a growing domestic and global demand for ethanol and biofuel drove sharp increases in corn and soybean prices (De La Torre Ugarte et al. 2007, Wallander et al. 2011, U.S. Department of Agriculture and Economic Research Service 2017). In addition, improvements in technology and assurances from government agriculture policies and insurance programs encouraged farmers to expand their operations and increase production of crop commodities (Tilman et al. 2002, U.S. Government Accountability Office 2007, Claassen et al. 2011, Faber et al. 2012). By 2013, corn and soybean commodities oversupplied the market and, as a result, demand has fallen, decreasing crop prices (U.S. Department of Agriculture and Economic Research Service 2016). Now, experts predict continued declines in crop prices over the next few years, causing a decrease in row crop plantings with some producers expanding their livestock operations, before crop prices rebound in the latter part of the decade (U.S. Department of Agriculture and Economic Research Service 2017).

The economic importance of agriculture to the communities in the PPPE is not to be taken lightly. While the agriculture industry of the whole United States consistently contributed an average of 1% to the nation's annual GDP from 1997-2015, Iowa, Minnesota, Montana, North Dakota, and South Dakota's average agriculture industry contributions to each state's annual GDP were significantly higher at 5%, 2%, 4%, 7%, and 8%, respectively (Bureau of Economic Analysis n.d.). Furthermore, while the nation's 5-year averages remained steady at 1% for the same time period, the 5-year averages for the five states of the PPPE rose 2 points from 4% to 6%, indicating a growth in the contribution of agriculture to each state's annual GDP.

As a consequence of the forces driving increased production of row crop commodities from 2006-2012, the rate of conversion of grasslands to cropland in the northern Great Plains increased to 1-5% annually (U.S. Government Accountability Office 2007, Searchinger et al. 2008, Claassen et al. 2011, Wright and Wimberly 2013). This was exceptionally alarming to PPPE conservation practitioners because although the PPPE is one of the most important ecoregions for agriculture and ecosystem services, it is also one of the most endangered (Samson et al. 2004, Hoekstra et al. 2005, Williams 2014). The widespread loss and fragmentation of perennial habitat is the primary reason for the decline of wildlife species (Osvaldo E. Sala et al. 2000, Brooks et al. 2002). Grassland bird populations are declining more than any other bird guild in North America (Macías-Duarte et al. 2009). Populations of waterbirds have declined precipitously because of habitat loss (Higgins et al. 2002). The black-tailed prairie dog (*Cynomys ludovicianus*), a native plains keystone species on which many other species depend for

their survival, currently inhabits less than 3% of its historically occupied area (U.S. Fish and Wildlife Service 2009).

To salvage what remains of the PPPE, some land has been allocated to non-use preserves such as national and state parks (Samson et al. 2004). Additionally, there are several kinds of public land that are designed to meet multi-use objectives such as providing leases for cattle grazing and habitat for wildlife. Despite these wildlife habitat protection efforts, the disparity between habitat protection and habitat loss is resulting in a net decline in plains grasslands and prairie potholes (Hoekstra et al. 2005, Gascoigne et al. 2011). This decline jeopardizes the function of the ecosystems and the wellbeing of all of the species that depend on it, including human beings (Chapin et al. 2000). As long as the decision of how to use a piece of land lies with the individual landowner, partnerships between conservation practitioners and landowners will play a crucial role in the conservation of these ecosystems (Samson et al., 2004).

To that end, state and federal conservation agencies and nonprofit organizations implement a variety of voluntary incentive conservation programs for private landowners, which compensate landowners for implementing specific land use practices (Johnson 2000, Haufler et al. 2005, Burger Jr 2006, Brinson and Eckles 2011, Gleason et al. 2011). There are two primary types of conservation programs: working lands and land retirement (Reimer 2015). Working lands programs are a critical aspect to addressing the conservation needs on agricultural lands (Sorice et al. 2011). These kinds of programs offer both monetary (e.g. financial compensation and cost sharing) and nonmonetary (e.g.

technical assistance and assurances against regulation) incentives for conservation behaviors (Sorice et al. 2011, Mezzatesta et al. 2013). Land retirement pays landowners to take land out of production and working lands incentivizes the adoption of conservation practices by landowners, typically through cost-sharing programs.

The Conservation Reserve Program (CRP), a land retirement program, is the largest private-lands conservation program in the United States. It is a voluntary incentive land enrollment program, which pays farmers a yearly rental payment, for a contract of 10-15 years, in exchange for removing environmentally-sensitive land from agricultural production and planting grass and forb species that will improve environmental health and quality (U.S. Department of Agriculture n.d.). CRP is a well-known program with high satisfaction from participants (Allen and Haufler 2005, Reimer and Prokopy 2014). Land enrolled in CRP benefits the environment by improving water quality, enhancing wildlife habitat, reducing greenhouse gas emissions, protecting and enhancing soil productivity, reducing downstream flood damage, and benefitting water aquifer levels (U.S. Department of Agriculture n.d., Farrand and Ryan 2005).

Unfortunately, from 2007 to 2012, the USDA recorded a 25% decrease in the number of acres enrolled in federal conservation programs, including the Conservation Reserve, Wetlands Reserve, Farmable Wetlands, and Conservation Reserve Enhancement Programs (U.S. Department of Agriculture 2012). In the PPPE states of Iowa, Minnesota, Montana, North Dakota, and South Dakota, enrollment from 2007 to 2012 in CRP alone decreased by 17%, 15%, 28%, 30%, and 29%, respectively (U.S. Department of

Agriculture 2007, 2012). These results call for new ways to conserve the natural resources of the PPPE.

One such way is the application of social sciences to improve conservation practitioners' understanding of private landowners. A variety of factors influence landowners' land use decisions including science, society, policy, and economics (Crompton 2010). Studies have shown that conservation approaches that incorporate social considerations are more effective, efficient, and long-lasting (Stephenson and Mascia 2009). Because agricultural production requires direct interaction with the natural environment, there is a large body of research dedicated to understanding how cognitive factors affect agriculture producers' decisions. There are three main types of social science investigations into the relationships between farmers and ranchers and environmental conservation: adoption of conservation practices, participation in conservation programs, and classifying producers by types based on practices and attitudes (Reimer and Prokopy 2014).

Studies investigating agriculture producers' adoption of conservation practices are of interest to conservation practitioners throughout the world, from North America to Africa and Europe to India (Pretty and Shah 1997, Knowler and Bradshaw 2007). The majority of these studies are based on the Theory of Planned Behavior (TPB) (Reimer et al. 2012). The TPB suggests that behavior is caused by a person's behavioral intention towards an action, which is the result of their attitude, subjective norms, and perceived behavioral control (Ajzen 1985). Attitudes are defined as psychological constructs, which

judge the desirability of a specific consequence of a behavior (Fulton et al. 1996). Building on the TPB, additional research suggests that habit, moral obligation, and self-identity may also affect a person's behavioral intention and influence their behavior (Burton 2004a). Still, other researchers maintain that the TPB alone is insufficient in explaining behavior and call for the incorporation of an actual control factor through the addition of the Derived Demand Theory (Lynne et al. 1988, 1995). Regardless, several studies have successfully applied the TPB to understand the behavior of farmers and ranchers, including the adoption of conservation practices (Carr and Tait 1990, Beedell and Rehman 1999, Torell et al. 2001, Burton 2004b, Reimer et al. 2012, Willcox et al. 2012, Henderson et al. 2014)

Voluntary incentive conservation programs are the primary tools used by governments throughout Canada, the United States, and Europe to increase conservation behavior among agriculture producers (Burton et al. 2008, Henderson et al. 2014, Reimer and Prokopy 2014). There have been numerous studies investigating motivations and barriers to participation in agriculture conservation programs. Some studies have found a lack of awareness about programs among potential participants and that the complexity of programs, both in variety and enrollment process, is a significant barrier to participation (Kabii and Horwitz 2006, Reimer and Prokopy 2014). One study identified a clear need for conservation programs to reflect the target's attitudes including the perceived benefits of participating, as well as recognizing anticipated problems (Willcox and Giuliano 2011).

Additionally, several studies demonstrate that people who participate in conservation programs have pro-environmental attitudes and that programs allow the adoption of conservation practices by reducing financial barriers (Macdonald and Johnson 2000, Reimer and Prokopy 2014). However, many people who do not participate in conservation programs often believe conservation is incongruous with agriculture and/or do not trust the program administrators (Sorice et al. 2011, Henderson et al. 2014). Unfortunately, from the standpoint of achieving conservation goals, the voluntary nature of conservation programs does not yield sufficient conservation achievements because of the spatial variation in participants (Lewis et al. 2011). It has been suggested that these types of programs are not a long-term solution to environmental conservation needs and that programs that help build social capital by paying for results and allowing landowners to devise their own methods could potentially change the culture of agriculture to be more environmentally positive (Burton et al. 2008).

Classification systems are typical of scientific investigations attempting to understand a variety of observations (Emtage et al. 2006). This phenomenon is popular among social scientists' efforts to understand the diversity of landowners' attitudes and practices. Typically, social scientists divide people into types by their attitudes to identify who would most likely participate in conservation efforts. The most basic typologies use research on attitudes to create a dichotomy of landowners: farmers and ranchers or those who conserve and those who do not (Jansujwicz et al. 2013, Sulemana and James Jr 2014, Turner et al. 2014). Other researchers developed typologies that recognize a variety of influences on conservation decisions including economics, policy, aesthetics,

responsibility, family, communities, culture, and future plans (Rowe et al. 2001, Busck 2002, Gentner and Tanaka 2002, Maybery et al. 2005, Reimer et al. 2012).

While these social science studies greatly contribute to the academic literature by explaining the variety of factors affecting agriculture producers' land use decisions, they do not provide conservation practitioners with an easy method for incorporating social science into their conservation efforts, to improve their conservation efforts in the PPPE. But, social scientists have long developed tools to quantify the diversity of people's attitudes and values towards the natural environment.

The New Ecological Paradigm (NEP) scale, can be argued to be social science's first published effort to measure people's environmental attitudes (Catton Jr and Dunlap 1978, 1980). Developed in the late 1970s, originally named the New Environmental Paradigm scale, the NEP is based on the premise of a dichotomy in environmental attitudes: anthropocentric or ecocentric. An anthropocentric viewpoint is derived from Judeo-Christian religions where man dominates all of nature and can use it in any way he sees fit. An ecocentric viewpoint holds humans as one of many species on earth, all of which combined, make up a thriving world.

The revision of the New Environmental Paradigm into the New Ecological Paradigm, allowed for the expansion of possible environmental attitudes as well as making it more reliable and in modern parlance (Dunlap et al. 2000). This new NEP scale contains 15 items, instead of the original 12, and addresses the same major four concepts:

humans are an exceptional part of a complex interdependent ecosystem community, humans are influenced by the responses of the biophysical environment to the changes made to natural processes, the biophysical environment constrains human affairs, and even the best science and technology are subject to the laws of nature, which ultimately limits the growth of all aspects of human societies. Both of these versions of the NEP have been used many times to measure environmental attitudes around the world. Often times, these scales were used to take the environmental temperature of the general public (Catton Jr and Dunlap 1978, 1980, Dunlap et al. 2000) but they also were used to understand environmental attitudes of specific groups of people (Albrecht et al. 1982, Edgell and Nowell 1989, Pierce et al. 1999).

The Human and Nature (HaN) scale, developed in Western Europe, is another example of an instrument to measure people's attitudes towards the environment (De Groot et al. 2011). The HaN moves beyond Dunlap's (Catton Jr and Dunlap 1980) traditional dichotomous view of the environment because it includes an anthropocentric relationship category, Mastery of Nature, as well as three differentiations of ecocentrism: Guardianship of Nature, Partnership with Nature, and Participation in Nature. A Guardianship of Nature relationship is characterized by a preservationist ethic of responsible caring for nature. Partnership relationships hold an intrinsic value of nature, humans, and the intensity and harmony of their relationship. Finally, a Participation in Nature relationship represents a feeling of spiritual connectedness with the great whole of nature. The HaN was used to study human-nature relationships throughout Western Europe in the first decade of the 2000s (De Groot et al. 2011).

In the early 1980s the Wildlife Attitudes scale was used as a "barometer of environmental concern" (Kellert and Berry 1981). As part of a national study of American attitudes, knowledge, and behaviors towards wildlife and natural habitats, Kellert and Berry developed nine-attitudinal scales characteristic of peoples' primary interests in wildlife. A Naturalistic attitude focused on an emotional connection to wildlife and the outdoors. An Ecologistic attitude was concerned with the environment as a community and the relationships between different components. A Humanistic attitude was characteristic of people who had a strong interest and affection for individual animals and charismatic megafauna. A person with a Moralistic attitude focused on the humane and ethical treatment of animals. Scientistic attitudes towards wildlife were interested in the biophysical attributes of animals. An Aesthetic attitude focused on the physical attractiveness of animals or their use as symbols. A Utilitarian attitude valued animals for their practical and material use by humans. A Dominionistic attitude was characterized by a desire for mastery over animals, particularly in hunting. Finally, a Negativistic attitude was evident in people's avoidance, dislike, or fear of animals.

The Wildlife Attitudes scale has been used extensively to examine people's cognitive factors related to wildlife. For example, the Wildlife Attitudes scale has been used to investigate the divisive issue of black-tailed prairie dog conservation and the proposed reintroduction of the prairie dog's obligate predator, the endangered black-footed ferret (Reading and Kellert 1993). Results showed that ranchers, the stakeholders most likely to be influenced by the proposed reintroduction, had high Negativistic,

Dominionistic, and Utilitarian scores and low scores on the Moralistic, Humanistic, and Naturalistic attitude scales. These results were used to predict intense conflict should the black-footed ferret reintroduction move forward without addressing the attitudes of ranchers.

Perhaps the most well-known scale in the United States today is the Wildlife Values Orientation (WVO) scale (Teel and Manfredo 2009). The WVO was developed to measure people's values for wildlife and provide conservation practitioners with a method for incorporating the variety of human values for wildlife into wildlife management practices. The WVO consists of a combination of two scales measuring a person's Mutualism or Domination orientation towards wildlife. Mutualism is a person's tendency to view humans as part of a larger ecological community where humans, wildlife, and nature all have equal rights. Domination is again derived from Judeo-Christian religions and is a person's tendency to view humans as separate from wildlife and nature and as having mastery over all. When combined via cross-tabulation there are four categories in which human values for wildlife fall: Traditionalists, Mutualists, Pluralists, and Distanced. Traditionalists exhibit a strong alignment with a Domination orientation and weak Mutualism tendencies. These individuals are called Traditionalists because Americans have traditionally viewed wildlife and nature in terms of their utility to humans. Mutualists have a strong Mutualist orientation and a weak orientation towards Domination. Pluralists tend to score highly on both the Mutualist and Domination scales leading to a desire to balance both the utility of natural resources for humans with an appreciation of the intrinsic value of nature and wildlife. Finally, wildlife does not play

an important role for Distanced individuals and some may even be fearful of wildlife.

The WVO has been used extensively by researchers to analyze wildlife management policies in the face of changing human populations, such as the reintroductions of controversial endangered species and to examine conflicts between stakeholder groups (Bright and Manfredo 1996, Manfredo and Zinn 1996, Manfredo et al. 2003). The WVO has also been used to assess attitudes towards wildlife across 19 states in the western U.S., to help managers understand conflict surrounding wildlife management policy (Teel et al. 2010). The WVO is currently being used to measure attitudes towards wildlife throughout the country and the results will be exceptionally useful in evaluating national wildlife management policies such as the Endangered Species Act.

While the above four scales produced groundbreaking results contributing to the body of knowledge about people's diverse values and attitudes toward the environment, nature, and wildlife, none of them were suitable for understanding agricultural land use decisions affecting a whole ecosystem. Additionally, up until this point, social science investigations of private landowners' land use decisions in the PPPE have been severely lacking. PPPE conservation practitioners need a better understanding of the landowners' demographics, attitudes, values, and behaviors towards the land they use, in order to improve the effectiveness of their conservation initiatives.

2. Dissertation Objectives

Conserving native habitat on private land in the PPPE is a complex problem. The issue of habitat conservation is typically approached by determining the habitat requirements of various species, from a natural science standpoint, notwithstanding the fact that the actions that alter the habitat in the first place were made on a social basis (Bennett et al. 2017). Furthermore, despite knowledge of strong social and cultural ties to the land among farmers and ranchers, financial incentive programs are often provided as the sole solution for increasing conservation efforts (Rashford et al. 2011). To advance conservation efforts of native habitat on private land in the PPPE, we need to improve our understanding of private landowners and their operations, within the context of habitat conservation.

The principal objective of this research was to improve the conservation community's understanding of farming and ranching private landowners in the PPPE. The ultimate goal of this work was to help conservation practitioners identify common ground between habitat conservation goals and the values of farmers and ranchers, to improve habitat conservation efforts. The chief methodological approach was a mail survey of private landowners in the states of Iowa, Minnesota, Montana, North Dakota, and South Dakota. I worked with each state to tailor their questionnaires to address their individual state conservation needs. Data from Iowa and Montana were not used in the chapters below because the contents of their questionnaires did not contribute to the research questions being addressed.

The dissertation objectives were:

1. Develop and evaluate the Land Use Value scale to measure and understand landowners' values for the land they use;
2. Use the Land Use Value scale to identify attitudes and motivations for and/or against conservation behaviors to inform conservation efforts;
3. Apply information about farmers and ranchers in the PPPE to evaluate U.S. Farm Bill Conservation Programs and determine ways to improve conservation outcomes.

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CHAPTER 2: THE LAND USE VALUE SCALE: A PRACTICAL TOOL FOR UNDERSTANDING DECISIONS OF AGRICULTURE PRODUCERS

1. Abstract

To address the environmental impact of agriculture, conservation professionals need to understand the land use decisions made by farmers and ranchers. The majority of land in the U.S. is privately owned and approximately half of that is used for agriculture. I developed a tool for determining conservation land use values of farmers and ranchers. I used principal axis factoring and reliability analysis to identify six items representing Human-centered values and seven items representing Nature-centered values. I used a survey of South Dakota's private landowners to evaluate the 13-item Land Use Value (LUV) scale's predictive validity. The LUV model identified four LUV types of farmers and ranchers, which successfully predicted attitudes, motivations, and behaviors related to conservation through analysis of variance and chi-square tests. The LUV model may allow conservation professionals to align conservation policy, programs, and messaging with the land use values of farmers and ranchers, to improve conservation outcomes.

2. Key words

Agriculture, attitudes, behaviors, conservation, land use values, motivations.

Grassland ecosystems provide both direct and indirect benefits to humans in the form of ecosystem services (Sala and Paruelo 1997). The direct benefits of grasslands are obvious in how humans use the grassland ecosystem for agricultural production of crops and

livestock. Indirect benefits often go unrecognized but include water quality improvement, carbon sequestration, soil conservation, wildlife habitat, and weather amelioration. Ecosystem services are acquired when the ecosystem is functioning properly (Hooper et al. 2005), which requires a large and biodiverse assemblage of species (Loreau et al. 2001). Central North American Grasslands [the Great Plains], are one of the most threatened ecosystems in the world, with a high risk of losing ecological function, due to over 50% having been converted to human dominated uses (Hoekstra et al. 2005, Commission for Environmental Cooperation 2010).

In the Great Plains, the primary human dominated of land is agriculture. "Land in farms" is private land used to produce agricultural goods for economic gains (U.S. Department of Agriculture and National Agricultural Statistics Service 2013). The states encompassing the Great Plains: Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, and Wyoming (Bailey 1998) have an estimated 84-87% privately owned land (Natural Resources Council of Maine 2000, Vincent et al. 2014). According to the U.S. Census (U.S. Census Bureau 2012) and the U.S. Department of Agriculture (U.S. Department of Agriculture and National Agricultural Statistics Service 2013), those same Great Plains states have approximately 71% "land in farms."

The environmental impact of agriculture, especially that of large-scale conventional monocultures, can be severe (Foley et al. 2005). Farming techniques used to maximize production, such as soil drainage and application of fertilizers, pesticides, and herbicides,

are a major contributor to soil erosion and water pollution (Carpenter et al. 1998, Goolsby et al. 2001). Farm equipment, livestock, and practices like conventional tillage, emit gases and particles causing air pollution and contributing to climate change (Skinner et al. 1997, Robertson et al. 2000, Cambra-López et al. 2010). Agriculture also affects wildlife through conversion and degradation of habitat (Mattison and Norris 2005). The impacts of agriculture are not contained but affect miles around the source and often the entire downstream watershed (Goolsby et al. 2001, Robertson and Swinton 2005).

Given expectations for rising demands of agricultural goods, experts predict an increasing prevalence of large-scale monocultures and cumulative impacts on the environment (Tilman et al. 2001, 2002). Economies of size are well-established in farming and the U.S. Department of Agriculture (U.S. Department of Agriculture and National Agricultural Statistics Service 2012, 2013, 2014, 2015, 2016) reports a decline in the number of farms and an increase in the average farm size, indicating an increase in large-scale farms.

Agricultural markets are notoriously volatile with slim margins. The recent elevated demand for biofuel feedstock and the expansion of agricultural exports, starting in 2006 and peaking in 2012 (U.S. Department of Agriculture and Economic Research Service 2017b), resulted in record high prices for corn and soybeans (U.S. Department of Agriculture and Economic Research Service 2016) and encouraged farmers to increase land conversion rates 1-5% (Wright and Wimberly 2013). In addition to increasing crop prices, government subsidies and crop insurance programs incite some landowners to

convert even marginally-productive land to row crops (Stephens et al. 2008, Faber et al. 2012). These conversions represent an even greater threat to the ecosystem because conventional large-scale monocultures offer little to no ecological value and have large environmental footprints (Papendick et al. 1986, Searchinger et al. 2008). In a demonstration of supply and demand, the increase in production of crop commodities oversupplied the market by 2013 and since then crop prices have fallen (U.S. Department of Agriculture and Economic Research Service 2016). Experts predict crop prices will continue to fall over the next several years, causing a reduction in crop plantings, primarily corn, until rebounding in the latter part of the decade (U.S. Department of Agriculture and Economic Research Service 2017a).

In these tumultuous times, farmers and ranchers are looking for ways to stabilize their operations and incomes. Conservation professionals are defined as people who work with the natural environment for long-term sustainability and ecosystem health. Many have been working with farmers and ranchers for decades to offer voluntary conservation programs and practices intended to reduce operation costs, protect the environment, and are usually stimulated with technical and/or monetary incentives, but have varying results (Pretty and Shah 1997, Lewis et al. 2011).

Researchers have studied motivations and barriers of agriculture producers to participation in conservation programs (Kabii and Horwitz 2006, Burton et al. 2008, Sorice et al. 2011, Willcox and Giuliano 2011, Henderson et al. 2014, Reimer and Prokopy 2014) and adoption of conservation practices (Lynne et al. 1988, Macdonald and

Johnson 2000, Reimer et al. 2012). Some researchers have developed typologies of farmers and ranchers that describe their differences and similarities (Beus and Dunlap 1990, Busck 2002, Gentner and Tanaka 2002, Jackson-Smith and Buttel 2003, Maybery et al. 2005, Sulemana and James Jr 2014). While these studies contribute to the academic literature by identifying the personal factors of farmers and ranchers that are most closely associated with their productive behavior, they do not provide conservation professionals with an easy way to incorporate the variety of farming and ranching personal factors into their efforts.

Most studies of agriculture producers' personal factors are grounded in the Theory of Planned Behavior (TPB; Ajzen 1985). The TPB maintains that human behavior is the result of attitudes, subjective norms, and perceived behavioral control, formed in response to a specific context, affecting a person's behavioral intention and subsequently their behavior. Research that extends the TPB indicates that in certain contexts three additional variables: habit, moral obligation, and self-identity may also contribute to behavior (Burton 2004). A more basic approach to understanding human behavior indicates that values are the precursors of attitudes and the foundation of behavior (Kellert 1980). Values, as compared to other behavioral variables, are more general, fewer in number, and focus on the attainment of basic human needs, such as power, well-being, and enlightenment (Clark 2002). Measuring values is theorized to be a good way to understand and predict general behavior, like that of farmers and ranchers and their land use and production practice decisions (Fulton et al. 1996). This research is based on the TBP and the objectives are to develop an understanding of the way land use values

affect attitudes and behaviors of agriculture producers, while also providing conservation professionals with a practical tool for evaluating and improving conservation policy and messaging, in order to increase the success of their efforts.

3. Study Area

This research was conducted in South Dakota, from March 2015 through May 2016, which lies in the northern mixed grassland (Ricketts et al. 1999) and Middle Missouri freshwater ecoregions (Abell et al. 2000). Approximately 85% of the land in South Dakota is privately owned (Coughlin 2014) and 88% is "land in farms" (U.S. Department of Agriculture and National Agricultural Statistics Service 2016).

4. Methods

Initial Scale Development

I developed the Land Use Value [LUV] scale in three steps, first creating, evaluating, and reducing a large number of items using a convenience sample, then creating, evaluating, and reducing additional items called for by the initial analysis with another convenience sample, and finally testing the reduced items using a random sample of South Dakota landowners. In creating the Land Use Value scale, I first identified nine basic land use value categories that reflected the types of attitudes farm and ranch producers might have for their land and the environment. Categories were developed from a literature review values, beliefs, and attitudes people have about their surrounding natural environments (Kellert 1980, Dunlap et al. 2000, Mayer and Frantz 2004, Teel and Manfredo 2009, De Groot et al. 2011, Cross and Fulton 2015). For this purpose, I defined "land" as the soil,

vegetation, broader habitat, and inhabiting fish and wildlife species, which also can be considered the whole natural environment on and around the owned land.

The nine basic land use value categories are:

1. Affect, Spiritual Connection, Distance: The personal emotional experience with land, or lack of;
2. Biodiversity: Maintaining the diversity of species;
3. Cultural Norms: Appropriate behaviors as defined by relevant social groups;
4. Environmental Balance, Sustainable Use: People as distinct from land but emphasizing wise use for the long-term utility;
5. Mastery, Domination: People as distinct from land and having the right to do whatever they want with it;
6. Mutualism: People as equal with land and emphasizing land's intrinsic value;
7. Nostalgia, Symbols, Aesthetic: The physical appearance of land and its sentimental symbolic meaning;
8. Obligation, Responsibility, Stewardship: People above land with the duty of taking care of it;
9. Utility: The practical use of land to benefit humans.

Next, I developed 3-10 items for each of these nine basic land use value categories, which resulted in 50 total items (Appendix A; Fabrigar et al. 1999). After the initial evaluation of these items, discussed below, a tenth category, Restoration, "The need to restore the land to its original condition" was added with 11 additional items. Items

reflected thoughts and behaviors that could be attributed to a farmer and/or rancher about how they value the land they use.

My convenience sampling frame consisted of adults (≥ 18 years of age) affiliated with South Dakota State University (SDSU), including students, employees, and their associates, and affiliates of the state wildlife and natural resource departments in Iowa, Minnesota, North Dakota, and South Dakota. Participants were asked to choose their level of agreement or disagreement for each item on a seven-point Likert scale, from "1 = strongly disagree" to "7 = strongly agree."

I collected data for the initial evaluation of the items using paper and online surveys administered from SDSU and Survey Monkey (www.surveymonkey.com) during March – June 2015. At SDSU, I sent emails soliciting participation from professors of large classes of undergraduate and graduate students in the following subjects: Agriculture, Animal Science, Biology, Computer Science, Economics, Graphic Design, History, Wildlife and Fisheries, and Writing. Some professors offered class time to complete the paper survey, others offered extra credit to students who completed the survey online, and other professors simply sent the web link to the online survey to their students. All participants affiliated with the state wildlife and natural resource departments completed the survey online. I had 1,061 individuals respond to the initial survey of 50 statements and 125 individuals responded to the 11 restoration statements.

Factor Analysis

To develop the 15-items tested with the South Dakota landowner sample, I analyzed the initial results from the convenience sample using SPSS (IBM Corporation 2013). I conducted an exploratory factor analysis to identify latent factors grouping similar statements into the dimensions of Land Use Values. The observed variables were the 61 items used to describe the initial ten land use value categories and the Land Use Value dimensions were the underlying latent factors explaining how the observed variables were related. I used the Shapiro-Wilk test for normality to determine whether the data were normally distributed. To determine if sampling was adequate, I followed with the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and interpreted KMO = 0.70 – 0.79 as "middling," 0.80 – 0.89 as "meritorious, and 0.90 – 1.00 as "marvelous" (Cerny and Kaiser 1977). I used Bartlett's tests of sphericity to determine if item responses were correlated and interpreted significance as indicating the presence of orthogonal items (Dziuban and Shirkey 1974). I required both an adequate sample and orthogonal items to conduct factor analysis. I used principal axis factoring with varimax rotation and Kaiser normalization to measure the patterns of correlations among underlying latent factors of the LUV statements in terms of coefficient factor loadings. I removed items with too low factor loadings and factors with only one item. I used Spearman's rank correlation to measure the degree of association between the factors. I combined the items of factors that were highly correlated with each other but treated items of uncorrelated factors as distinct.

Reliability Analysis

I used scale reliability analysis to remove items, one by one, that least contributed to the underlying factor the scale measured. I judged the level of contribution by the Cronbach's alpha score of each item. Items that lowered the Cronbach's alpha score of the scale below 0.7 were removed (Vaske 2008). Removal of items was ceased when the highest Cronbach's alpha score coincided with the least number of statements, producing the most effective and efficient scale of items to represent the underlying components. This project was approved as exempt human subjects research [Approval #: IRB-1502028-EXM].

Evaluation of the 15-item Scale

I randomized the order of the Land Use Value 15 items and reviewed the scale with three South Dakota Department of Game, Fish and Parks (SDGFP) advisory groups of 10-15 local landowners each. I also consulted with agency personnel in the state wildlife and natural resources departments of Iowa, Minnesota, North Dakota, and South Dakota. Overall, the 15-item Land Use Value scale was well received. Subtle word changes were made to create a final version and improve its suitability for private landowners in South Dakota and surrounding states.

The South Dakota landowner sample came from a database of private farm and ranch landowners, purchased by the SDGFP from a marketing company (GoLeads.com). SDGFP staff randomly selected 2,000 individuals each from counties east and west of the Missouri River. The population was defined as individuals owning a minimum of 100 acres. Data were collected, January through May 2016, via mail surveys following a

modified Dillman method (Dillman 2000). The questionnaires, reminder postcards, and second mailing of questionnaires were mailed from SDSU. Questionnaires were 12 pages in length, including a cover page and a comment page. The mailing included a postage-paid business-reply envelope for return of questionnaires and a cover letter to obtain informed consent. The cover letter explained the study's purpose, that participation was completely voluntary, data provided would be confidential and secure, data use plans, where and when the results would be found, and provided contact information for the researchers. I asked recipients wishing to decline participation to return blank questionnaires.

The questionnaire included measures of attitudes/motivations, behaviors, and demographics. I asked participants to rank their level of agreement to disagreement on a 7-point Likert scale to the 15 items in the LUV scale. For the attitudes and motivations questions, I asked about the importance of different reasons ($N = 20$) for land use decisions such as protecting water quality, attracting and feeding bees and butterflies, preventing soil erosion, improving productivity; the importance of different types of wildlife ($N = 12$), such as deer, coyotes, songbirds; and the importance of reasons ($N = 14$) for participating in a U.S. Farm Bill Conservation Program. Importance was measured on a 4-point scale [0 = not important, 1 = slightly, 2 = moderately, and 3 = very]. For the behavior questions, I asked whether the individual had converted grass to row crops, drained, moved, or minimized wet areas, enrolled in a conservation program, and about their use of 22 land use practices [i.e., done in the past, currently do and/or plan to do], such as using conservation tillage, herbicides, lethal wildlife control methods,

planting pollinator seed mixes. Examples of demographic questions included the person's gender, age, landowner type, amount of land owned/operated, years of experience with farming/ranching, and questions about hunting.

I assessed nonresponse bias by sending a two-page nonresponse questionnaire and a new cover letter to 1,000 randomly selected non-respondents. In addition to the 15-item Land Use Value scale and five demographic questions, I also asked about eligibility for the survey [i.e., recipient deceased, no longer owned land, or no longer makes land use decisions].

I repeated the above-described factor and reliability analysis procedures to analyze the 15-item Land Use Value scale using the South Dakota landowner sample data. After identifying the underlying dimensions via factor analysis, I calculated the overall data mean of responses to create a midpoint in each dimension and combined them via cross-tabulation. I then plotted each individual's mean score on each dimension to determine their LUV type. I analyzed the LUV types, and tested the reliability and validity of the LUV scale, with analysis of variance and chi-square tests of attitude, motivation, behavior, and demographic variables from the survey. Post hoc tests were evaluated as significant at $\alpha < 0.05$ based on Tamhane's T2 method when Levene's test for equality of variances was significant and Scheffé's test when Levene's test for equality of variances was not significant. Effect sizes of Cramer's V were interpreted as "small" or "minimal" = 0.10 – 0.29, "medium" or "typical" = 0.30 – 0.49, and "large" or "substantial" ≥ 0.50 (for 2 X 2 chi-square tables; modified by phi divided by the square root of *df* for larger

chi-square tables), and effect sizes of eta were interpreted as “small” or “minimal” = 0.10 – 0.24, “medium” or “typical” = 0.25 – 0.36, and “large” or “substantial” ≥ 0.37 (Cohen 1988, Vaske 2008). This project was approved as exempt human subjects’ research [Approval #: IRB-1410016-EXM].

5. Results

Testing the 50 items from the initial nine basic land use value categories explained 39.5% of the variance observed, with a 0.931 Kaiser-Meyer-Olkin measure of sampling adequacy and $P \leq 0.001$ significance on Bartlett’s test of sphericity. Principal axis factoring, with varimax rotation, converged in 19 iterations creating 11 factors. I removed five factors due too low or too few factor loadings/correlations among items on each factor. Testing the 11 restoration items explained 41.6% of the variance observed with a 0.729 Kaiser-Meyer-Olkin measure of sampling adequacy and $P \leq 0.001$ significance on Bartlett's test of sphericity. Principal axis factoring, with varimax rotation, converged in six iterations creating four factors. I removed two factors due to too few factor loadings. I identified a scale of 15 total items, six-item Nature-centered and Human-centered scales with Cronbach’s alphas of 0.825 and 0.831, respectively, and a -0.441 correlation, and a 3-item Restoration scale with a 0.744 Cronbach’s alpha (Table 1).

Removing undeliverable questionnaires and ineligible addresses, I estimated 3,027 eligible participants in the South Dakota sample. I received 1,093 completed survey questionnaires and 151 nonresponse questionnaires (36% response rate). I did not detect any differences between respondents and nonrespondents, but acknowledge that an

undetected response bias could still exist (Groves 2006). The Shapiro-Wilk test for normality showed my data was not normally distributed ($P \leq 0.001$). The Kaiser-Meyer-Olkin score (0.841) and the significant Bartlett's test of sphericity ($P \leq 0.001$), indicated factor analysis as an appropriate statistical test. Principal axis factoring converged in five iterations extracting three factors. All items loaded sufficiently onto one of the three factors. When compared to the original 15-item scale, all items loaded onto the same factors except one Restoration scale item, "Restored lands maximize both productivity and ecosystem function," now loaded onto the Nature-centered scale.

Spearman's rank correlation found the Restoration factor to be significantly correlated with Nature-centered factor ($r = 0.268$, $P \leq 0.001$) and the Human-centered factor ($r = 0.166$, $P \leq 0.001$). The Nature-centered factor and the Human-centered factor were slightly negatively correlated but the correlation was not significant ($r = -0.059$, $P = 0.080$). Reliability analysis found that all of the items for the Human-centered factor and the Nature-centered factor, including the above mentioned item from the Restoration factor, contributed to a high reliability score, with a Cronbach's alpha of 0.792 and 0.821, respectively (Table 2). Reliability analysis for the Restoration factor found a Cronbach's alpha of 0.482, signifying the scale's items were not reliable, and as a result the factor was removed from the Land Use Value scale. The final scale contained 13 items, seven Nature-centered items and six Human-centered items (Table 2).

I examined the distribution of scores for each factor and the Nature-centered factor was heavily skewed to the right ($M = 5.91$, $s = 0.985$) (Fig. 1). The mean for the Human-

centered factor was 4.37 (s = 1.337). I used the mean of each factor as the mid-point and crossed them, identifying four LUV types (Fig. 2). Plotting each person's score of the two factors gave us their individual LUV type. The LUV types are: Humans First with above average score on the Human-centered factor and below average score on the Nature-centered factor (20% of the sample), Nature First with above average score on the Nature-centered factor and below average score on the Human-centered factor (29% of the sample), Interconnected with above average scores on both factors (29% of the sample), and Disconnected with below average scores on both factors (22% of the sample).

Although the four LUV types had relatively similar rankings for the importance of wildlife categories, from highest, pheasant (*Phasianus colchicus*), grouse (*Tetraoninae*), to lowest, reptiles and amphibians, the Nature First and Interconnected Land Use Value types rated 11 out of 12 wildlife categories significantly more important than the Humans First group (Table 3). The effect sizes (η = 0.179 − 0.320) indicated a "small" or "minimal" to "medium" or "typical" relationship between the Land Use Value types and the importance of the wildlife categories (Cohen 1988, Vaske 2008). Generally, the Disconnected group's rating of the importance of the various wildlife categories was slightly higher than the ratings by the Humans First group, although statistically similar. The wildlife category, "Coyotes, foxes, mountain lions, etc." was the only category similarly rated by all four LUV types and was the next to lowest in importance, overall.

Landowners' rating of the importance of 20 reasons/motivations for using various land use practices gave the highest rating to "prevent soil erosion" and the lowest rating to "protect fisheries" (Table 4). Nineteen of the 20 reasons had significant differences among the four LUV types; "Financial considerations," rated relatively low in importance, was the one similarly rated reason. There were "small" or "minimal" to "medium" or "typical" effects for the significant variables ($\eta = 0.106 - 0.314$) (Cohen 1988, Vaske 2008). The Nature First and Interconnected LUV types rated motivations that favored the environment significantly higher than the Humans First types.

Landowners' rating of the importance of 14 reasons for participating in a U.S. Farm Bill Conservation Program gave the highest rating to "financial considerations" and the lowest rating to "provide habitat for monarch butterflies" (Table 5). Twelve of the 14 reasons had significant differences among the four LUV types and "financial considerations" and "tax credits/benefits" were the only two reasons similarly rated. For the 12 significant reasons, the Nature First group generally had the highest ratings, followed by the Interconnected, Disconnected, and Humans First groups giving decreasing importance ratings. The Nature First group rated five reasons for participating in a U.S. Farm Bill Conservation Program related to the environment higher than their rating of "financial considerations." Eleven of the 12 significant variables, had "medium" or "typical" to "large" or "substantial" effect sizes ($\eta = 0.285 - 0.375$) and "provide river/stream buffer strips" had a "small" or "minimal" effect size ($\eta = 0.229$) (Cohen 1988, Vaske 2008).

I measured landowners' responses to 22 land use practices [i.e., done in the past, currently, and/or plan to in the future] as a dichotomous yes or no variable for each land use practice. Landowners reported similar participation rates for 12 of 22 land use practices (Table 6). For nine of the ten significantly different practices among the four LUV types, the Nature First group reported the highest participation rate for practices that favored the environment although all effect sizes were "small" or "minimal" (η = 0.098 – 0.224) (Cohen 1988, Vaske 2008) (Table 7).

About 21% of the sample of South Dakota landowners reported they converted pasture or other grasslands to crops, 14% reported draining, moving or minimizing wet areas on land they own/operate in the past 10 years (2005 – 2015), and 56% reported enrolling some land in a U.S. Farm Bill Conservation Program in the past 30 years. For all three of these behaviors, the four LUV types reported statistically similar participation rates (P = 0.082, P = 0.157, and P = 0.095; respectively).

The demographic variables: gender (84% males, 12% females; P = 0.867), landowner type (59% farmer, 15% rancher, 12% both, and 14% neither; P = 0.105 or 86% farmer and/or rancher, 14% non-farmer/non-rancher; P = 0.121), land owned/operated (12% < 160 acres, 42% 161-140 acres, 36% 641 – 3,840 acres, and 10% > 3,840 acres; P = 0.602), and hunter (46% no, 54% yes; P = 0.397) were not significantly related to the four LUV types. Age was significantly related to the LUV types. The Interconnected LUV type had the oldest mean age (65 years), the Humans First group had the youngest mean age (52 years), and Nature First (58 years) and Interconnected (57 years) groups

were intermediate in age (ANOVA F (3; 856) = 26.47, $P \leq 0.001$, $\eta = 0.291$). The highest percent of farmers and ranchers with greater than 30 years of experience (74%) belonged to the Interconnected group, compared to 54% for Humans First, 52% for Disconnected, and 49% for Nature First ($\chi^2 = 59.97$, $df = 9$, $P \leq 0.001$, Cramer's $V = 0.162$).

6. Discussion

It is important for conservation professionals to understand farmer and rancher attitudes regarding wildlife, production practices/land use, and conservation programs, as well as conservation-related behaviors, to improve conservation outcomes. The results from South Dakota results show the LUV scale is an easy tool that can be used to significantly predict conservation attitudes and behaviors.

Examination of wildlife species importance showed that landowners with Nature First and Interconnected LUV types reported significantly more positive and supportive attitudes towards wildlife than their Humans First counterparts. Thus, the 13-item LUV scale provides conservation professionals with an easy tool to predict landowner responses to wildlife management and for developing messaging related to wildlife in general and to specific species in particular. For example, if wildlife management policies are presented in a way that favors wildlife, such as emphasizing the way the policy will improve habitat or provide water or shelter for wildlife, they receive significant positive support from the Nature First and Interconnected LUV types.

In my evaluation of 20 reported reasons for landowners choosing various land use practices, the LUV types were significantly different in all but one, "Financial considerations," discussed below. The majority of significantly different reasons for land use practice choice can be grouped into two themes, reasons all producers feel are important to their land use decisions and reasons associated with environmental conservation. Farmers and ranchers, regardless of LUV type, reported preventing soil erosion, controlling unwanted plants and insects, improving productivity, and producing agricultural goods, were important considerations in making land use decisions. However, farmers and ranchers with high Nature-centered values, the Nature First and Interconnected LUV types, reported significantly higher importance for environmental reasons for production practice choices related to water quality, vegetation recovery, plant diversity, pollinators, and providing water, shelter, and habitat for wildlife. The LUV scale explains producers' choice of production practice, namely that some producers have stronger positive values for their natural environment and exhibit a higher likelihood of choosing conservation practices that benefit the environment.

The LUV scale again proved to be a strong tool for understanding landowner differences in reasons for participating in a U.S. Farm Bill Conservation Program. "Financial considerations," a reason that was similarly valued by all LUV types, received the mean highest rating for landowners' participation. However, the Nature First and Interconnected LUV types attributed equal or more importance to environmental reasons related to game, water and soil quality, native grass, and pollinators. Conversely, Humans First landowners rated all environmental reasons much lower than finances, their

participation being motivated by the economic incentives offered by U.S. Farm Bill Conservation Programs. Conservation professionals can use the LUV scale to identify willing participants for conservation programs, depending on the type of conservation focus and availability of funds, to direct conservation efforts and improve target messaging.

Of all the reasons for land use decisions and participation in a U.S Farm Bill Conservation Program, only reasons associated with economics were similarly valued by all LUV types. This finding is informative about how all agriculture producers similarly view their role as generators of economic value. As Reimer et al. (2012) stated, the "nature of agriculture [is] as a productive use of land to generate economic goods." These results demonstrate the need for conservation professionals to recognize and acknowledge the inherent economic foundation of all agricultural production.

What is particularly interesting, given the similar valuation of economic reasons by all LUV types, is the high level of importance given to finances in decisions about participation in a U.S. Farm Bill Conservation Program, compared to the low level of importance given to finances in decisions about production practices. This disparity may be due to the inherent nature of conservation programs: to alleviate the financial burden of conservation efforts. Several studies have shown that producers who participate in conservation programs are already inclined towards conservation but their biggest barrier to implementing conservation practices is cost (Lynne et al. 1988, Macdonald and Johnson 2000, Sorice et al. 2011, Reimer and Prokopy 2014). The relatively low ranking

of "Financial considerations" on production practice choice indicates the uniform lack of importance farmers and ranchers place on finances when making their land use decisions and is consistent with the literature (Torell et al. 2001, Busck 2002, Gentner and Tanaka 2002). It is also noteworthy that all LUV types ranked "Tax credits," an economic reason for participating in a U.S. Farm Bill Conservation Program, similarly low (11th out of 14 reasons) compared to "Financial considerations" ranking first. This may be due to a lack of awareness of what constitutes a tax credit and/or their availability or how psychological perceptions of tax credits differ from financial incentives (Madrian 2014). These results demonstrate the need for conservation professionals to keep in mind the importance of financial incentives as a motivator for participation in U.S. Farm Bill Conservation Programs but to be careful not to reduce all farmer and rancher motivations to a financial bottom line. In addition, if tax credits are used as incentives, conservation professionals need to increase landowner awareness of them and/or understand why they are perceived as a less desirable incentive.

The culmination of the LUV scale is its ability to differentiate between producers who implement conservation practices and other producers. The Nature First and Interconnected LUV types reported higher participation in conservation practices such as managing for wildlife, including pollinators, using non-lethal damage prevention methods, and using a written grazing management plan. Behaviors with similarly high or low participation rates among all LUV types may be considered as either uniformly common or uncommon, respectively, to all farmers and ranchers and best explained by the TBP (Ajzen 1985). The TBP maintains that values, being a precursor to attitudes, are

not the only factors that affect behavior, perceived behavioral control and subjective norms are also influential. While the LUV scale is designed to measure producers' conservation land use values, these results show these values are not the primary behavioral factor influencing these statistically similar land use practices. If these similarly valued land use practices are important to conservation outcomes, further research is needed to identify and describe the factors responsible for their implementation.

I used extensive methods to develop and test the LUV scale. The results demonstrate that the LUV scale validly differentiates between landowners' attitudes towards wildlife, reasons for production practice choices, and reasons for participation in U.S. Farm Bill conservation programs. The LUV scale is also useful in understanding conservation-related behaviors.

7. Management Implications

These results show that the LUV scale is a useful tool for improving our understanding of the decisions farmers and ranchers make on their land. By identifying landowners' LUV types, conservation professionals will know the landowners' conservation land use values and be able to predict their responses to new and changed management policies. In conclusion, conservation professionals can use knowledge of the LUV types to tailor messaging and recruitment efforts for conservation initiatives to improve conservation outcomes.

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10. Figures

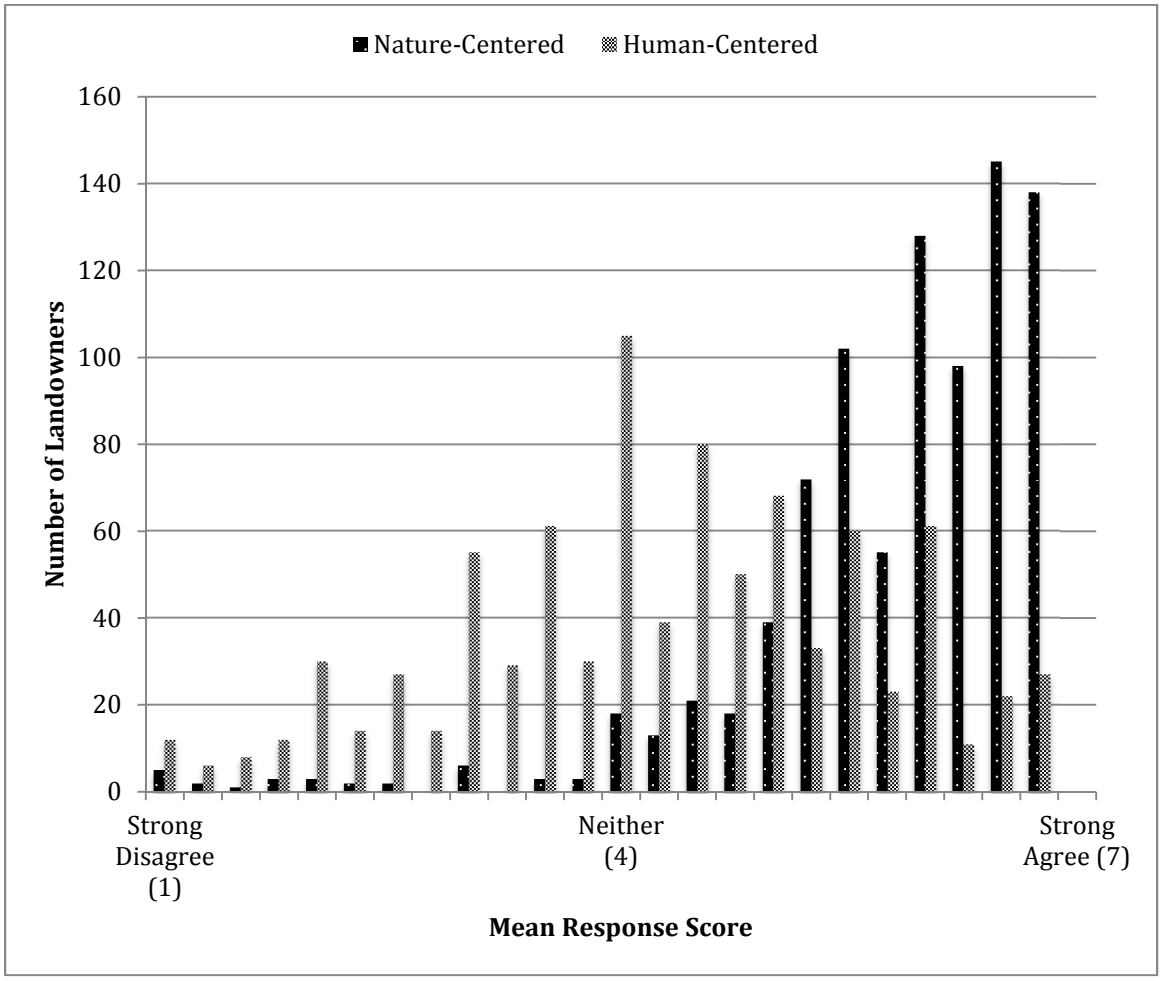

Figure 1. South Dakota landowners' mean scores from the Land Use Value scale on the Nature-centered and Human-centered dimensions.

Figure 2. The four Land Use Value types resulting from crossing the Human-centered and Nature-centered dimensions.

11. Tables

Table 1. The Land Use Value scale items of each factor, prior to evaluation using a sample of South Dakota landowners, and the random order used in the survey, May 2015.

Random order no.	Land Use Value factor and factor's items	Cronbach's alpha
Nature-centered		0.82
15	Farmers and ranchers are only temporary trustees of the land and it is their responsibility to take good care of it for future generations.	
3	Farmers and ranchers have an obligation to protect the soil, water, plants, habitat, and fish and wildlife on their land.	
9	If you take care of the land, it will take care of you.	
1	The quality of the land is positively influenced by the diversity of native plants and animals that live on and around it.	
8	All parts of the ecosystem, down to the microorganisms in the soil, are important for proper functioning.	
1	The diversity of plants and wildlife in an area is a sign of the quality of the natural environment.	
Human-centered		0.83
12	The needs of farmers and ranchers should take priority over the conservation of land.	
6	Farmers and ranchers should focus on maximizing production on their land regardless of environmental costs.	
4	The best use of land should be determined by the amount of profit that can be earned annually.	
13	Farmers and ranchers are masters of the land.	
7	Farmers and ranchers have the right to use the soil, water, plants, and animals on their land in any way they see fit.	
2	Because farmers' and ranchers' livelihoods depend on the land, they are the best stewards of the land.	
Restoration		0.74
14	We should restore the ecosystem to the way it was when the pioneers first arrived.	
10	Restored lands maximize both productivity and ecosystem function.	
5	Large-scale restoration, across the entire ecosystem, is required to improve the condition of the land.	

Table 2. The Land Use Value scale items of each factor, after evaluation with a sample of South Dakota landowners, and their random order used in the survey, May 2016.

Random order no.	Land Use Value factor and factor's items	Cronbach's alpha
Nature-centered		0.82
13	Farmers and ranchers are only temporary trustees of the land and it is their responsibility to take good care of it for future generations.	
3	Farmers and ranchers have an obligation to protect the soil, water, plants, habitat, and fish and wildlife on their land.	
8	If you take care of the land, it will take care of you.	
10	The quality of the land is positively influenced by the diversity of native plants and animals that live on and around it.	
7	All parts of the ecosystem, down to the microorganisms in the soil, are important for proper functioning.	
1	The diversity of plants and wildlife in an area is a sign of the quality of the natural environment.	
9	Restored lands maximize both productivity and ecosystem function.	
Human-centered		0.79
11	The needs of farmers and ranchers should take priority over the conservation of land.	
5	Farmers and ranchers should focus on maximizing production on their land regardless of environmental costs.	
4	The best use of land should be determined by the amount of profit that can be earned annually.	
12	Farmers and ranchers are masters of the land.	
6	Farmers and ranchers have the right to use the soil, water, plants, and animals on their land in any way they see fit.	
2	Because farmers' and ranchers' livelihoods depend on the land, they are the best stewards of the land.	

Table 3. South Dakota landowners' rating of the mean importance[a,b] of various wildlife categories to decisions made about land use, analyzed by the four Land Use Value types, May 2016.

Wildlife Categories	Mean Importance	Humans First	Nature First	Inter-connected	Dis-connected
1. Pheasant, grouse, etc.	2.0	1.6A	2.2BC	2.2B	1.9C
ANOVA F (3; 825) = 18.61, $P \leq 0.001$, $\eta = 0.252$					
2. Songbirds	1.8	1.2A	2.1B	2.0B	1.5C
ANOVA F (3; 806) = 30.66, $P \leq 0.001$, $\eta = 0.320$					
3. Bees	1.7	1.4A	2.1B	1.9B	1.5A
ANOVA F (3; 801) = 16.30, $P \leq 0.001$, $\eta = 0.240$					
4. Monarchs and other butterflies	1.5	1.1A	1.9B	1.7B	1.4A
ANOVA F (3; 802) = 19.96, $P \leq 0.001$, $\eta = 0.264$					
5. Deer, elk, antelope, etc.	1.5	1.2A	1.7B	1.6BC	1.4AC
ANOVA F (3; 818) = 8.98, $P \leq 0.001$, $\eta = 0.179$					
6. Ducks, geese, shorebirds, etc.	1.2	0.9A	1.4B	1.4B	1.1A
ANOVA F (3; 808) = 12.34, $P \leq 0.001$, $\eta = 0.209$					
7. Hawks, eagles, owls, etc.	1.2	0.8A	1.5B	1.3B	1.0A
ANOVA F (3; 805) = 13.77, $P \leq 0.001$, $\eta = 0.221$					
8. Fish	1.0	0.7A	1.1B	1.1B	0.8A
ANOVA F (3; 789) = 8.93, $P \leq 0.001$, $\eta = 0.181$					
9. Other insects	0.9	0.7A	1.2B	0.9BC	0.8AC
ANOVA F (3; 785) = 10.15, $P \leq 0.001$, $\eta = 0.193$					
10. Other non-game mammals	0.8	0.5A	1.1B	0.9B	0.6A
ANOVA F (3; 785) = 14.23, $P \leq 0.001$, $\eta = 0.227$					
11. Coyotes, foxes, mountain lions, etc.	0.8	0.7A	0.8A	0.9A	0.6A
ANOVA F (3; 808) = 1.94, $p = 0.122$, $\eta = 0.085$					
12. Reptiles &	0.6	0.3A	0.8B	0.6BC	0.4AC

amphibians
ANOVA F (3; 790) = 10.93, $P \leq 0.001$, $\eta = 0.200$

[a] Importance scale: 0 = Not, 1 = Slightly, 2 = Moderately, and 3 = Very.

[b] For each numbered row, means for the Land Use Value types with the same letter are statistically similar and means with different letters are significantly different.

Table 4. South Dakota landowners' rating of the mean importance[a,b] of reasons for using various land use practices, analyzed by the four Land Use Value types, May 2016.

Land Use Reasons	Mean Importance	Humans First	Nature First	Inter-connected	Dis-connected
1) Prevent soil erosion	2.6	2.4A	2.7B	2.6BC	2.5AC
ANOVA F (3; 800) = 6.32, $P \leq 0.001$, $\eta = 0.152$					
2) Remove/control unwanted plants	2.5	2.4A	2.6AC	2.6BC	2.3A
ANOVA F (3; 815) = 5.92, $P \leq 0.001$, $\eta = 0.146$					
3) Improve productivity	2.4	2.4AB	2.4AB	2.5B	2.2A
ANOVA F (3; 804) = 4.99, $P = 0.002$, $\eta = 0.135$					
4) Produce & grow agricultural crops	2.4	2.4AB	2.3AB	2.5A	2.2B
ANOVA F (3; 810) = 3.93, $P = 0.008$, $\eta = 0.120$					
5) Protect water quality	2.3	2.1A	2.5B	2.4B	2.1A
ANOVA F (3; 789) = 10.78, $P \leq 0.001$, $\eta = 0.198$					
6) Control insects	1.9	1.9AB	2.0AB	2.1A	1.8B
ANOVA F (3; 785) = 4.18, $P = 0.006$, $\eta = 0.125$					
7) Provide habitat for wildlife	1.9	1.5A	2.2B	2.0B	1.8C
ANOVA F (3; 799) = 21.65, $P \leq 0.001$, $\eta = 0.274$					
8) Provide shelter for wildlife	1.9	1.4A	2.3B	2.0C	1.8C
ANOVA F (3; 813) = 28.64, $P \leq 0.001$, $\eta = 0.309$					
9) Encourage quick vegetation recovery	1.8	1.5A	2.1B	2.0B	1.6A
ANOVA F (3; 782) = 16.32, $P \leq 0.001$, $\eta = 0.243$					
10) Raise & produce livestock	1.8	1.8AB	1.8AB	2.1A	1.7B
ANOVA F (3; 797) = 3.18, $P = 0.024$, $\eta = 0.109$					
11) Produce & grow feedstock	1.7	1.7AB	1.8AB	1.8A	1.5B
ANOVA F (3; 780) = 2.94, $P = 0.032$, $\eta = 0.106$					
12) Increase plant diversity	1.7	1.4A	2.0B	1.8B	1.5A

ANOVA F (3; 766) = 14.15, $P \leq 0.001$, $\eta = 0.229$					
13) Provide food for wildlife	1.7	1.1A	2.0B	1.8BC	1.6C
ANOVA F (3; 784) = 28.57, $P \leq 0.001$, $\eta = 0.314$					
14) Provide water for wildlife	1.6	1.1A	1.9B	1.8B	1.4C
ANOVA F (3; 787) = 24.90, $P \leq 0.001$, $\eta = 0.294$					
15) Attract and feed bees & butterflies	1.6	1.2A	2.0B	1.7B	1.3A
ANOVA F (3; 783) = 20.42, $P \leq 0.001$, $\eta = 0.269$					
16) Increase grazing season length	1.5	1.3A	1.5AB	1.7B	1.4A
ANOVA F (3; 792) = 4.25, $P = 0.005$, $\eta = 0.126$					
17) Control wildlife	1.5	1.3A	1.5AB	1.7B	1.5AB
ANOVA F (3; 787) = 5.78, $P = 0.001$, $\eta = 0.147$					
18) Financial considerations	1.5	1.5A	1.4A	1.6A	1.3A
ANOVA F (3; 784) = 2.19, $P = 0.088$, $\eta = 0.091$					
19) Protect riparian vegetation	1.3	0.9A	1.6B	1.4BC	1.1AC
ANOVA F (3; 738) = 18.04, $P \leq 0.001$, $\eta = 0.261$					
20) Protect fisheries	0.8	0.6A	1.0B	0.8AB	0.7A
ANOVA F (3; 769) = 5.06, $P = 0.0021$, $\eta = 0.139$					

[a] Importance scale: 0 = Not, 1 = Slightly, 2 = Moderately, and 3 = Very.

[b] For each numbered row, means for the Land Use Value types with the same letter are statistically similar and means with different letters are significantly different.

Table 5. Mean importance[a,b] of reasons for participating in a U.S. Farm Bill Conservation Program, reported by South Dakota landowners, analyzed by the four Land Use Value types, May 2016.

Reasons	Mean Importance	Humans First	Nature First	Inter-connected	Dis-connected
1) Financial compensation	2.0	2.0A	2.0A	2.2A	1.8A
ANOVA F (3; 503) = 0.95, P = 0.416, η = 0.075					
2) Improve habitat for game species	1.9	1.4A	2.4B	2.0C	1.8C
ANOVA F (3; 468) = 25.59, $P \leq 0.001$, η = 0.375					
3) Improve water quality	1.9	1.4A	2.3B	2.0BC	1.7AC
ANOVA F (3; 499) = 19.12, $P \leq 0.001$, η = 0.321					
4) Improve soil quality	1.8	1.6A	2.3B	2.1BC	1.8AC
ANOVA F (3; 468) = 13.82, $P \leq 0.001$, η = 0.285					
5) Support native grass plantings	1.7	1.2A	2.1B	1.9B	1.5A
ANOVA F (3; 499) = 20.11, $P \leq 0.001$, η = 0.328					
6) Provide habitat buffers for upland birds	1.6	1.0A	2.1B	1.7C	1.4C
ANOVA F (3; 491) = 23.42, $P \leq 0.001$, η = 0.354					
7) Provide habitat for pollinators	1.6	1.0A	2.0B	1.8B	1.3A
ANOVA F (3; 493) = 23.87, $P \leq 0.001$, η = 0.356					
8) Improve habitat for non-game wildlife	1.5	0.9A	1.9B	1.6C	1.3C
ANOVA F (3; 494) = 26.50, $P \leq 0.001$, η = 0.372					
9) Increase plant diversity	1.4	0.9A	1.9B	1.5C	1.1A
ANOVA F (3; 486) = 24.35, $P \leq 0.001$, η = 0.361					
10) Protect endangered species	1.4	0.8A	1.9B	1.4C	1.1AC
ANOVA F (3; 459) = 20.15, $P \leq 0.001$, η = 0.341					
11) Tax credits/benefits	1.2	1.0A	1.3A	1.4A	1.2A
ANOVA F (3; 450) = 1.81, P = 0.144, η = 0.109					
12) Provide shallow water (wet) areas	1.2	0.6A	1.5B	1.3BC	1.0C
ANOVA F (3; 488) = 18.97, $P \leq 0.001$, η = 0.323					
13) Provide river/stream buffer strips	1.1	0.7A	1.4B	1.1BC	1.0AC

ANOVA F (3; 485) = 8.93, $P \leq 0.001$, $\eta = 0.229$					
14) Provide habitat for monarch butterflies	1.1	0.6A	1.5B	1.3B	0.7A
ANOVA F (3; 457) = 18.11, $P \leq 0.001$, $\eta = 0.326$					

[a] Importance scale: 0 = Not, 1 = Slightly, 2 = Moderately, and 3 = Very.

[b] For each numbered row, means for the Land Use Value types with the same letter are statistically similar and means with different letters are significantly different.

Table 6. Participation in twelve land use practices reported by South Dakota landowners that were statistically similar among the four Land Use Value types, May 2016.

Practice	Mean Reported Participation Rate	ANOVA F (3; 859)	P-value
Use herbicides	84%	1.59	0.190
Use conservation tillage practices	78%	0.64	0.592
Conduct soil testing	74%	0.03	0.994
Control agricultural run-off	72%	2.33	0.073
Use insecticide	67%	1.65	0.176
Allow free reasonable public hunting access	64%	1.29	0.275
Provide livestock with water tanks	61%	0.39	0.764
Use integrated pest management	54%	0.21	0.891
Use lethal methods (e.g., shooting, trapping) to prevent/reduce property damage	45%	0.61	0.610
Plant cover crops	44%	1.64	0.179
Plant and maintain filter strips	30%	0.93	0.425
Provide hunting access for a fee	10%	0.38	0.768

Table 7. Mean participation[a,b] in land use practices reported by South Dakota landowners analyzed by the four Land Use Value types, May 2016.

Practice	Mean Reported Participation Rate	Humans First	Nature First	Inter-connected	Dis-connected
Rotate crops	83%	89%A	81%A	84%A	78%B
ANOVA F (3; 859) = 2.79, P = 0.040, η = 0.098					
Plant trees and shrubs (e.g. shelter belts)	75%	71%A	84%B	72%A	73%A
ANOVA F (3; 859) = 4.32, P = 0.005, η = 0.122					
Manage/maintain wetlands for wildlife	51%	39%A	58%B	52%B	51%AB
ANOVA F (3; 859) = 5.51, P = 0.001, η = 0.137					
Manage grasslands for wildlife	50%	40%A	57%B	49%AB	50%AB
ANOVA F (3; 859) = 3.98, P = 0.008, η = 0.117					
Plant food plots	37%	26%A	42%B	38%B	39%B
ANOVA F (3; 859) = 4.52, P = 0.004, η = 0.125					
Use non-lethal methods to prevent/reduce property damage	35%	29%A	43%B	33%AB	34%AB
ANOVA F (3; 859) = 3.56, P = 0.014, η = 0.111					
Establish or restore wetlands	30%	20%A	37%B	32%B	26%AB
ANOVA F (3; 859) = 5.18, P = 0.002, η = 0.133					
Plant pollinator seeds	23%	16%AC	31%B	25%AB	14%C
ANOVA F (3; 859) = 7.88, $P \leq$ 0.001, η = 0.164					
Protect milkweed to feed monarch larvae	20%	10%A	33%B	17%A	14%A
ANOVA F (3; 859) = 15.18, $P \leq$ 0.001, η = 0.224					
Use a written grazing management plan	15%	11%A	20%A	17%A	11%A
ANOVA F (3; 859) = 3.20, P = 0.023, η = 0.105					

[a] Values were analyzed as the proportion of the sample participating in the activity, as defined, and are reported here as the percent participating.

[b] For each numbered row, means for the Land Use Value types with the same letter are statistically similar and means with different letters are significantly different.

12. Appendix

ITEMS USED TO MEASURE TEN BASIC LAND USE VALUE CATEGORIES

Affect, Spiritual Connection, Distanced
I feel a strong spiritual connection with the natural community around me.
Spending time alone outdoors gives perspective to my daily problems and helps me focus on the bigger picture.
I am deeply saddened by the destruction of the natural environment.
Biodiversity
The diversity of plants and wildlife in an area is a sign of the quality of the natural environment.
Farming/ranching should be thought of as a part of a larger natural community of soil, water, native plants and wildlife.
The quality of the land is positively influenced by the diversity of native plants and animals that live on or around it.
All parts of the ecosystem, down to the microorganisms in the soil, are important for proper functioning of the landscape.
Cultural Norms
Using the same production practices as the rest of the community is the best thing for the larger natural environment.
Preserving the farming or ranching lifestyle is the primary reason for being a farmer or rancher.
An individual's farming and ranching practices are influenced by neighboring practices.
Farmers and ranchers who exploit the land have a bad reputation and are outcasts from the community.
Being accepted by the farming and ranching community is an important part of a farmer or rancher's identity.
Being a good neighbor is an important part of being a farmer/rancher.
Social pressure has no influence on farming and ranching land management decisions.
Environmental balance and sustainable use
Nature is resilient and can recover from whatever you do to it.
Farmers and ranchers should respect their role in sharing the larger natural environment with plants and animals
It is impossible for people to live in harmony with nature
If you take care of the land, it will take care of you.
Farmers and ranchers can help maintain natural balance when using production practices that might harm the land by adding conservation practices to make up for the damage
All farming and ranching practices inevitably degrade the land.
A good producer respects the limits of the land and doesn't take more than it can give.

Mastery and domination
Farmers and ranchers are masters of the land.
The needs of farmers and ranchers should take priority over the conservation of land.
Farmers and ranchers should manage land for human advantage.
Human beings are the most valuable species.
Mutualism
All parts of the ecosystem, including people, are equally important.
Farmers and ranchers are just one part of the greater land ecosystem.
Land is a part of a complex web of interconnected systems of which farmers and ranchers are a part.
Nostalgia, symbol, and aesthetic
I do my best to avoid change.
I often find that the way things have always been done is the best way.
Multi-generational farms/ranches are legacies that need to be honored.
Obligation, responsibility, and stewardship
I think there should be stiff fines and penalties for people who damage the land.
Farmers and ranchers have an obligation to protect the soil, water, plants, habitat, and fish and wildlife on their land.
Farmers and ranchers have a responsibility to be mindful of their effects on the natural environment in which they operate.
The purpose of the land is to benefit people.
Farming and ranching practices do not have a lasting effect on the land.
Farmers and ranchers are only temporary trustees of the land and it is their responsibility to take good care of it for future generations.
Land needs to be managed and controlled or it will deteriorate.
The best farming and ranching practices conserve water quality and wildlife habitat.
When there is a variety of plants and wildlife on a farmer or rancher's land, they are doing a good job stewarding the land.
Because farmers' and ranchers' livelihoods depend on the land, they are the best stewards of the land.
Utility
Making a profit from the land is the most important goal for a farmer/rancher.
Natural resources are our greatest economic assets.
It is important to conserve native habitat, even if it is not directly beneficial to human beings.
Farmers and ranchers have the right to use the soil, water, plants, and animals on their land in any way they see fit.
The best use of land should be determined by the amount of profit that can be earned annually.
Farmer and ranchers have an obligation to make sure their farms/ranches are financially self-sufficient.

Only fish and wildlife game species have value.
Farmers and ranchers do not need to consider the limits of the land.
Farmers/ranchers should focus on maximizing production on their land regardless of environmental costs.
Restoration
We should restore the ecosystem to the way it was when the pioneers first arrived.
Restored lands optimize both productivity and ecosystem function.
Restoration is any activity that helps maximize the productivity of the land.
Large-scale restoration, across the entire ecosystem, is required to improve the condition of the land.
The purpose of restoration should be to restore native habitat.
All farming and ranching jeopardizes ecosystem function.
There is no need to restore the land; it is natural for ecosystems to change over time.
Restoration of the land can only be achieved by allowing time for nature to replenish itself.
Restoring small areas of native habitat has little to no effect on the overall health of the ecosystem.
Improvements in technology replace the need to work within natural cycles of restoration.
By restoring native habitat we can improve the health of the land.

CHAPTER 3: A VALUES-BASED PRIVATE LANDOWNER TYPLOGY TO UNDERSTAND AND PREDICT CONSERVATION BEHAVIOR

1. Abstract

The most effective conservation initiatives are guided by both natural and social science; however, most conservation initiatives are based on natural science alone. Utilizing social science in conservation policy and practice is difficult due to multiple barriers. Practical social science tools can assist conservation practitioners in incorporating the diversity of stakeholders into their efforts. The Land Use Value (LUV) typology can help improve conservation practitioners' understanding of private landowners' land use decisions. Using a mail survey I asked private landowners in the Minnesota, North Dakota, and South Dakota about their demographics, motivations, behaviors, and values for land use through the LUV scale. By asking respondents about their level of agreement or disagreement with 13 statements, the LUV typology identifies 4 types of land use values related to conservation and agriculture: Humans First, Nature First, Interconnected, and Disconnected. I used analysis of variance and chi-square tests to look for relationships between LUV types and other variables. The majority of all LUV types in my sample worked in agriculture and produced crops. Humans First LUV types were primarily focused on producing marketable crops, Nature First valued the environment and wildlife significantly more than the other LUV types, Interconnected types valued both the environment and production and when possible chose practices that maximized both, and Disconnected types focused on crop production. The LUV typology is a useful tool to

help evaluate and align grassland conservation practices, policy, and messaging with the land use values of landowners. Social science tools like this are critical to building the social science capacity of conservation professionals, in order to improve the effectiveness of conservation initiatives.

2. Keywords

Agriculture, grassland conservation, land use values, landowner typology, private land

3. Introduction

Environmental conservation initiatives attempt to ameliorate the negative impact human activities have on the earth. From climate change to the sixth mass extinction, conservation issues are increasing in number and severity (Pimm et al. 2014; Ceballos et al. 2015). The field of conservation biology has long recognized the importance of attending to social aspects of conservation efforts, and yet most conservation issues are primarily addressed through the application of natural science (Leopold 1949; Soulé 1985; Trombulak et al. 2004). Studies have shown that incorporating social considerations into conservation efforts is an effective and efficient way to produce long-lasting, successful conservation outcomes (Stephenson & Mascia 2009; Bennett et al. 2016). Unfortunately, integrating social science into conservation efforts is difficult because of ideological, institutional, knowledge, and capacity barriers (Bennett et al. 2017). I provide a case study of an imperiled ecosystem and my effort to build the social science capacity of conservation practitioners, to yield more effective conservation initiatives.

One of the most imperiled biomes in the world is the temperate grasslands biome in the United States (Hoekstra et al. 2005). The majority of U.S. grasslands lie in the Great Plains, of which approximately 71% are used for agriculture and 85% are privately owned (Bailey 1998; U.S. Department of Agriculture & National Agricultural Statistics Service 2013; Vincent et al. 2014). Recently, studies have shown an increased rate of conversion of remaining grasslands and surrounding wetlands to row crop agriculture in response to government agriculture policies, market price improvements, and technological advances (U.S. Government Accountability Office 2007; Lubowski et al. 2008; Wimberly et al. 2017). Conservation practitioners are concerned that ongoing conversion will jeopardize the integrity of the grassland ecosystem and are looking for ways to improve grassland conservation efforts (Polasky et al. 2011; Lark et al. 2015). My goal was to help improve conservation practitioners' understanding of private landowners' decisions, to inform conservation policy, programs, and messaging.

Social science studies demonstrated private landowners' decisions of whether or not to convert grasslands or wetlands to cropland and/or participate in or adopt conservation practices are based on biological, geological, meteorological, personal, social, political, and economic factors (Lynne et al. 1988; Busck 2002; Burton 2004; Maybery et al. 2005; Kabii & Horwitz 2006; Reimer et al. 2012; Wang et al. 2017; Wimberly et al. 2017). While conservation professionals want to conserve grasslands, the complexity of incorporating all of these factors into their conservation initiatives is impractical. In an effort to assist conservation practitioners, I deployed a social science tool to assist

practitioners in understanding private landowners' land use decisions through their segmentation by their land use values.

Conceptual Framework

Values are the most basic level of cognition and form the foundation of beliefs that affect all behavior (Fulton et al. 1996). Values transcend specific situations and provide overarching guidance in securing basic biological and social needs. Humans use values as principles and standards to evaluate the desirability of goals, methods for obtaining them, and to direct behavior (Manfredo et al. 2016). Because values are so fundamental to behavior, a central tenet of conservation strategy has been to change society's values to prioritize the environment (Leopold 1949; Bennett et al. 2016).

To understand the relationship between values and the actions of society, we must first understand how values develop in a society. Manfredo et al. (2017) provide a useful systems-approach overview of values in society. They contend that individual values arise as a result of learning how to meet basic life needs and are passed on to young children through internalization of social group norms. As society develops, values are self-perpetuated when members of the social group use them to guide construction of societal rules, organizations, and institutions. As a result, values are stable pillars entrenched in family units and society's establishments and are heavily resistant to change. Unfortunately, this means it is unlikely that society will reprioritize the environment in our lifetime, barring an extreme event, such as ecological collapse. As a

hopeful alternative, Manfredo et al. (2017) propose using knowledge of existing values to effect change in society that improves conservation outcomes.

The field of environmental conservation has long applied the values concept to understand behavior that affects natural resources and the environment (Fulton et al. 1996). Most commonly, social scientists developed typologies to classify people into groups marked by a unifying characteristic or trait in their approach to natural resources (Reading & Kellert 1993; Manfredo et al. 2016). Typologies are typical of scientific endeavors to understand a range of variation in observations (Emtage et al. 2006). As such, typologies can help conservation practitioners understand the diversity of motivations, attitudes, and behaviors of social groups responsible for target natural resources, to evaluate conservation policies and practices, improve outreach efforts, and link each type of person with their appropriate policy or advisory service (Jansujwicz et al. 2013).

For these reasons, I used the Land Use Value (LUV) scale to measure and understand the similarities and differences of landowners' LUV types in relation to temperate grassland conservation objectives (Sweikert & Gigliotti 2017). My research was guided by 3 questions: What motivations and behaviors are representative of each LUV type? How can conservation professionals use this information to improve conservation initiatives in the temperate grassland biome? Can value measurement provide natural-science-based conservation professionals with an easy way to incorporate social aspects into their conservation initiatives and improve their outcomes?

4. Methods

I surveyed private landowners in Minnesota (MN) (n = 3,000), North Dakota (ND) (n = 4,000), and South Dakota (SD) (n = 4,000) in collaboration with the Minnesota Department of Natural Resources (MNDNR), the North Dakota Game and Fish Department (NDGF), and South Dakota Department of Game, Fish and Parks (SDGFP). The MNDNR staff selected a random sample of landowners owning more than 33 hectares (80 acres) from a list maintained by the department. NDGF staff randomly selected 2,000 individuals each from counties east and west of the Missouri River, owning more than 16 hectares (40 acres), from a list maintained by their department. And, SDGFP selected a random sample of landowners owning more than 40 hectares (100 acres), 2,000 individuals each from counties east and west of the Missouri River, from a landowner database purchased from a marketing company (GoLeads.com).

I worked with these 3 state wildlife/natural resources departments to develop questionnaires and survey procedures and collected data via mail surveys, following a modified Dillman method, which included initial questionnaires, reminder postcards, and second questionnaires from December 31, 2015 through June 28, 2016 (Dillman 2000). The questionnaire and survey procedures were approved as exempt human subjects research (IRB-1410016-EXM). The questionnaires included the LUV scale, developed by Sweikert and Gigliotti (2017) (reproduced in Table 1), demographic items regarding age, gender, self-identified occupation, amount of land owned, percent of current land uses (row crops, grass/pasture, conservation programs, and unused) and hunting; motivations

measured by landowners' rating of the importance of 20 reasons underlying land use decisions, (e.g. improving productivity, providing shelter for wildlife, financial considerations) on a 4-point scale (0 = not important, 1 = slightly, 2 = moderately, and 3 = very); and participation in 24 behaviors (i.e., done in the past, currently do and/or plan to do) such as using insecticides, planting pollinator seeds, and converting grasslands and wetlands to crops.

To identify respondents' LUV types, I randomized the items in the LUV scale and asked respondents to rank their level of agreement to disagreement on a 7-point Likert scale for 6 items representing the Human-centered dimension and 7 items representing the Nature-centered dimension (Table 1). I used the overall data mean of both dimensions to divide each dimension in half and then determined each individual's LUV type by calculating their mean score on each dimension and crossing the two dimensions (Fig. 1). A score above the mean on the Human-centered dimension and a score below the mean on the Nature-centered dimension defined the Humans First LUV type and vice versa for the Nature First LUV Type. The Interconnected LUV type is defined by high scores on both dimensions and the Disconnected LUV type signifies low scores on both dimensions.

I used analysis of variance and chi-square tests to look for relationships between respondents' LUV types and their demographic, attitude, and behavior variables. Relationships were interpreted as significant at $\alpha \leq 0.05$. For the 20 questions measuring the importance of reasons/motivations underlying land use decisions, I used principal axis factoring to group item responses by underlying latent factors and then conducted a

reliability analysis to judge whether item groupings sufficiently represented the underlying factor with a Cronbach's alpha of at least 0.7 (Vaske 2008). I computed each person's factor's score by taking the mean of the items in each factor and used the aforementioned statistical tests to look for relationships among the LUV types. For post hoc tests I used Tamhane's T2 method when Levene's test for equality of variances was significant and Scheffé's S method when not significant. Effect size interpretations for phi (ϕ) were 0.10 – 0.29 = "small" or "minimal," 0.30 – 0.49 = "medium" or "typical," and ≥ 0.50 = "large" or "substantial," and Cramer's V effect sizes were calculated using the phi categories divided by the square root of *df* (Cohen 1988; Vaske 2008). Effect sizes for eta (η) were interpreted as 0.10 – 0.24 = "small" or "minimal," 0.25 – 0.36 = "medium" or "typical," and ≥ 0.37 = "large" or "substantial."

5. Results

Our adjusted sample size was 9,306 (removing undeliverable questionnaires and individuals who no longer have land), for which I received 2,649 completed questionnaires: 937 from MN, 770 from ND, and 942 from SD, for a 28% response rate. To test for nonresponse bias, I collaborated with each state to administer a one-page nonresponse questionnaire to all nonrespondents from MN (n = 1,588) and ND (n = 2,483) and 1,000 randomly selected nonrespondents from SD and received 178, 180, and 131 completed questionnaires, respectively. My respondent sample had higher percentages of landowners in the categories of land owned/operated greater than 518 hectares (1,280 acres) compared to the nonrespondent sample (24% vs. 16%) and the nonrespondent sample had higher percentages of landowners in the categories of land

owned/operated less than 65 hectares (161 acres) ($\chi^2 = 51.52$, $df = 6$, $p \leq 0.001$, Cramer's $V = 0.14$). The respondent sample had a lower percent of females (15%) compared to the nonrespondent sample (20%) ($\chi^2 = 8.17$, $df = 1$, $p = 0.004$, $\phi = 0.05$), and the respondent sample was slightly older (mean age = 67) compared to the nonrespondent sample (mean age = 65) (ANOVA F (1; 3010) = 9.15, $p = 0.003$, $\eta = 0.06$). However, the proportions of LUV types in the respondent sample were statistically similar to the nonrespondents ($\chi^2 = 6.35$, $df = 3$, $p = 0.096$, Cramer's $V = 0.05$).

Thirty percent of my sample fell into the Nature First LUV type, 24% were Humans First types, 26% were Interconnected types, and a fifth of my sample were Disconnected types (20%). All 3 states had similar percentages of Humans First and Nature First LUV types, but MN had significantly fewer Interconnected types and more Disconnected types compared to the Dakotas (Table 2). My data showed a significant increase in the percent of Humans First and Interconnected LUV types and decrease in Nature First and Disconnected LUV types with an increase in the amount of land owned (Fig. 2). Also, the Interconnected group had a slightly higher mean age than the other three LUV types (Table 2). In addition, there was no significant difference in the LUV types comparing hunters and non-hunters ($p = 0.775$) or males and females ($p = 0.071$).

Farmers had a higher percent of Humans First types, ranchers and non-agriculture landowners had a higher percent of Nature First types, and the combined farmer/rancher landowners had a higher percent of Interconnected types, compared to the other LUV types (Table 2). The Humans First and Interconnected LUV types had a higher percent

of landowners working in agriculture (farming and/or ranching) compared to Disconnected and Nature First LUV types (Table 2). Also, the Humans First LUV types had the highest percent of their land in crops and Nature First had the highest percent of their land in grass/pasture, enrolled in a conservation program, and unused remaining land, compared to the other LUV types (Table 2).

For the responses to the importance of 20 reasons for land use decisions, 4 underlying factors were related to wildlife, crops, livestock, and the environment, and two items, "Financial considerations" and "Control wildlife," were treated as separate variables due to low factor loading scores (Table 3). None of the 4 factors were correlated (p <0.001). Overall, landowners reported Crop reasons were the most important reason for making land use decisions (Table 4). The Humans First types rated Crop reasons significantly more important compared to Nature First and Disconnected types and Financial Considerations more important than Nature First types. Nature First types rated Environmental and Wildlife reasons significantly more important compared to all other LUV types. The Interconnected and Disconnected types were intermediate between Humans First and Nature First in half of the reason categories. In addition, the Interconnected types rated Crop reasons significantly more important than Nature First and Disconnected types and Livestock and Control Wildlife reasons significantly more important compared to all other LUV types. The Disconnected types rated Crop and Livestock reasons significantly less important than the other LUV types.

Five of the 24 land use practices (cover crops, filter strips, lethal wildlife control, provide hunting access for a fee, and convert grasslands to row crops) had statistically similar rates of participation by each LUV type (Table 5). Of the remaining 19 land use activities, 13 activities had significant differences between the Humans First and Nature First LUV types, which are the two types with the greatest value differences. The Humans First landowners reported significantly higher participation for herbicides, soil testing, insecticides, integrated past management, and convert wetlands to crops. The Nature First landowners reported significantly higher participation for shelterbelts, maintain wetlands for wildlife, maintain grasslands for wildlife, plant food plots, establish/restore wetlands, plant pollinator seeds, protect milkweed, and write a grazing plan. Out of all LUV types, the Interconnected types had the highest participation in conservation tillage, controlling run-off, providing water tanks for livestock, allowing free hunting access, and using a written grazing plan. Disconnected types had the lowest participation in conservation tillage and providing water tanks for livestock.

6. Discussion

Land Use Value Typology and Significance

All LUV types in my sample had several notable unifying characteristics including the fact that the mean age for all landowners was in their 60s, the majority of each LUV type worked in agriculture, and, despite differences in each LUV type's self-identified occupation, all LUV types primarily used their land to produce row crops. In addition, there were several land use practices in which all LUV types participated universally including lethal wildlife control and converting grasslands to row crops. For the

remaining variables, the biggest response differences between the Humans First and Nature First LUV types, however, there also were important differences distinguishing the Interconnected and Disconnected types. Conservation professionals may use this information to inform their understanding of landowners and improve their conservation efforts.

The Humans First LUV types primarily focused their energy on maximizing crop production and financial gains and were not interested in the wildlife or environmental uses of their land. Similar studies have shown conservation is incongruous with farmers who have a "farm as a business" attitude (Reimer et al. 2012). From these results, it is my opinion that the Human First types will consider adoption of conservation practices that provide financial benefits through reduced financial and temporal input costs and/or gains in crop production. Communication with Humans First LUV types, including messaging of available conservation practices and programs, must emphasize the financial benefits of participating and de-emphasize the environmental and wildlife benefits of the conservation efforts. The key to communicating with Humans First LUV types is to focus on the bottom line and quickly get to the point.

Although many of the Nature First types also primarily focus on maximizing crop production, in addition, they are strongly motivated by the environment and wildlife resulting in increased participation in environmental and wildlife friendly behaviors. Ranchers and non-agriculture landowners had higher proportions of the Nature First types. Many ranching practices are more wildlife friendly compared to row crop

agriculture practices, thus making it an easier decision for ranchers to participate in conservation practices than other occupations. The non-agriculture landowners may own land specifically for the environmental and wildlife benefits. The Nature First LUV types are the most environmentally friendly of all the LUV types and are most likely to adopt land use conservation practices and participate in conservation programs. Conservation messaging focusing on the environmental and wildlife benefits will be important in securing Nature First type landowners' participation in conservation programs.

The results for landowners in the Interconnected LUV type revealed the highest proportion of the combined farmer and rancher category. Interconnected LUV types were largely found in the Dakotas, own bigger parcels of land, were primarily motivated by crop and environmental reasons, and also were most likely to care for livestock, prevent and control erosion, and allow free hunting access. These results indicate that Interconnected LUV types value both the environment and agricultural production and chose practices that maximize both, when possible. Conservation practitioners can concentrate on Interconnected LUV types to implement best agriculture management practices that help maintain the symbiotic relationship between a healthy ecosystem and productive land use. Messaging targeting Interconnected LUV types should highlight both environmental and production benefits.

The Disconnected LUV types were the smallest portion of my sample, with MN having a significantly higher percent of Disconnected LUV types. Also, Disconnected types tended to own smaller parcels of land. Because MN has much larger and more numerous

urban areas than the Dakotas, it is possible that many Disconnected LUV types were people who primarily work in the urban and suburban areas and own farmland in the country. The Disconnected LUV types may be interested in participating in conservation programs; however, they may be less directly and regularly involved with agriculture and not aware of various conservation programs or how to participate. Reaching these people may require using communication channels outside the normal agricultural arena.

Utility of a Values-based Typology to Improve Conservation Efforts

My results show that the LUV model can be a useful tool to segment private landowners by environmental and wildlife motivations and behaviors. The information gained through this study provides a general understanding of the motivations and behaviors of landowners in MN, ND, and SD. I expect that an improved understanding of private landowners' values will lead to improved understanding of their land use decisions. Conservation professionals can use this information to predict responses of different landowner types to various conservation messages, programs, and policies and evaluate and develop conservation initiatives that encourage grassland friendly behavior, in accord with landowners' land use values.

To maximize the effectiveness of the LUV scale, it is important to identify its limitations. First and foremost, my results and the LUV type descriptions were based on means and proportions and are representative of the average LUV type landowner. While all landowners will fall into one of the LUV types, not all landowners will exhibit the motivations and behaviors characteristic of that LUV type. The LUV typology is meant

to assist conservation professionals in generally understanding the diversity of private landowners, not each individual landowner.

Second, while land use values, motivations, and practices vary among agriculture producers, it is important to remember that the primary goal of all agriculture producers is to use land to generate economic value. Economics are the inherent foundation of all agricultural production. Conservation policies, programs, and messaging that recognize and acknowledge this fundamental fact will be better received than those that do not.

Third, an important tenet of using social science is to always be aware of the context in which you are working (Clark 2002). Because production practices can have an effect on environmental and wildlife conservation goals it may be tempting for conservation professionals to try to apply the LUV typology to understand or predict crop and livestock production motivations and behaviors. This would be a mistake because the LUV scale was specifically designed to understand land use values as they relate to conservation, not production (Sweikert & Gigliotti 2017). Furthermore, because this scale was developed to understand private landowners in an agriculturally intensive grassland ecosystem in the Great Plains, the LUV scale may not be suitable for use in other geographic contexts. I suggest first piloting it to determine validity and reliability.

Private landowners are a diverse group of people and yet most conservation programs apply a homogeneous approach to private landowner conservation efforts. Attending to the diversity of landowners is crucial to ascertaining their support and cooperation for

conservation efforts. While it is impractical to tailor policies and programs to each individual, this research supports similar studies demonstrating the utility of typologies in classifying landowner's to better target outreach and communications (Emtage et al. 2006). The benefit of using a values-based landowner typology is that values are stable (Manfredo et al. 2017). Conservation practitioners can use the known value type distribution of a population of landowners to inform current and future conservation efforts. Tools like this are crucial to helping conservation practitioners bridge the gap between natural science and social science, both of which are critical to addressing our planet's growing conservation needs.

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8. Tables

Table 1. The Land Use Value scale (Sweikert & Gigliotti 2017).

Random Order No.	*Land Use Value Dimensions and Items*
Nature-centered Dimension	
13	Farmers and ranchers are only temporary trustees of the land and it is their responsibility to take good care of it for future generations.
3	Farmers and ranchers have an obligation to protect the soil, water, plants, habitat, and fish and wildlife on their land.
8	If you take care of the land, it will take care of you.
10	The quality of the land is positively influenced by the diversity of native plants and animals that live on and around it.
7	All parts of the ecosystem, down to the microorganisms in the soil, are important for proper functioning.
1	The diversity of plants and wildlife in an area is a sign of the quality of the natural environment.
9	Restored lands maximize both productivity and ecosystem function.
Human-centered Dimension	
11	The needs of farmers and ranchers should take priority over the conservation of land.
5	Farmers and ranchers should focus on maximizing production on their land regardless of environmental costs.
4	The best use of land should be determined by the amount of profit that can be earned annually.
12	Farmers and ranchers are masters of the land.
6	Farmers and ranchers have the right to use the soil, water, plants, and animals on their land in any way they see fit.
2	Because farmers' and ranchers' livelihoods depend on the land, they are the best stewards of the land.

Table 2. The distribution of Land Use Value (LUV) types among the sample, each state's residents, mean age, self-identified occupation, and percent land use.

Variables (Sample Percent)	*Land Use Value Types*			
	Humans First	*Nature First*	*Inter-connected*	*Dis-connected*
Percent state's residents in LUV types (χ^2 = 43.96, *df* = 6, $p < 0.001$, Cramer's $V = 0.09$)				
MN (37%)	25%	31%	20%	25%
ND (31%)	24%	30%	29%	16%
SD (32%)	23%	28%	30%	19%
Mean Age (ANOVA F (3; 2681) = 14.59, $p < 0.001$, $\eta = 0.13$)				
	63.6[a]	64.9[a]	68.0[b]	64.9[a]
Percent occupation in LUV types (χ^2 = 70.09, *df* = 9 $p < 0.001$, Cramer's $V = 0.11$)				
Farmer (56%)	28%	25%	25%	21%
Rancher (11%)	19%	33%	29%	19%
Farmer/Rancher (9%)	24%	27%	35%	13%
Non-Agriculture (24%)	17%	38%	19%	26%
Percent LUV types who: (χ^2 = 48.03, *df* = 3 $p < 0.001$, Cramer's $V = 0.15$)				
Work in Agriculture (76%)	83%	69%	82%	71%
Percent of land in each use by LUV types[1]				
(ANOVA F (3; 1966) = 20.63, $p < 0.001$, $\eta = 0.16$)				
Row Crops (56%)	65%[a]	48%[b]	58%[c]	56%[c]
(ANOVA F (3; 1966) = 5.60, $p = 0.001$, $\eta = 0.09$)				
Grass/Pasture (27%)	23%[a]	31%[b]	28%[ab]	26%[ab]
(ANOVA F (3; 1966) = 5.87, $p = 0.001$, $\eta = 0.09$)				
Conservation (7%)	5%[a]	9%[b]	7%[ab]	7%[ab]
(ANOVA F (3; 1966) = 13.65, $p < 0.001$, $\eta = 0.14$)				
Remaining[2] (9%)	7%[a]	12%[b]	7%[a]	10%[b]

[1] For each row, values for LUV types with the same letter are statistically similar and values with different letters are significantly different.
[2]Homestead, trees, bushes, wetlands.

Table 3. Factors underlying 20 motivations (reasons)[1] for land use decisions.

Factor Name and Underlying Reasons	*Cronbach's Alpha*
Wildlife	0.87
Provide shelter for wildlife	
Provide habitat for wildlife	
Protect fisheries	
Provide water for wildlife	
Provide food for wildlife	
Crops	0.82
Produce and grow agricultural crops	
Remove/control unwanted plants	
Prevent soil erosion	
Improve productivity	
Control insects	
Livestock	0.86
Raise and produce livestock	
Increase grazing season length	
Produce and grow livestock	
Environmental	0.82
Protect riparian vegetation	
Increase plant diversity	
Protect water quality	
Attract and feed bees & butterflies	
Encourage quick vegetation recovery	

[1] Two variables did not load sufficiently on any of the factors: "Financial considerations" and "Control wildlife" and were treated as separate variables.

Table 4. The mean importance of various reasons to land use decisions and each Land Use Value type.[1]

	Land Use Value Types						
Sample	*Humans First*	*Nature First*	*Inter-connected*	*Dis-connected*	*F-ratio*	*P-Value*	*Eta*
Crop Reasons							
3.3	3.4[a]	3.3[b]	3.5[a]	3.1[c]	24.04	<0.001	0.18
Environmental Reasons							
2.8	2.4[a]	3.1[b]	2.9[c]	2.6[d]	89.18	<0.001	0.34
Financial Considerations							
2.7	2.8[a]	2.6[bc]	2.8[ac]	2.6[ac]	4.47	0.004	0.08
Wildlife Reasons							
2.6	2.2[a]	3.0[b]	2.7[c]	2.6[d]	95.06	<0.001	0.35
Control Wildlife							
2.5	2.3[a]	2.5[a]	2.7[b]	2.4[a]	10.49	<0.001	0.12
Livestock Reasons							
2.4	2.4[a]	2.4[a]	2.6[b]	2.2[c]	14.15	<0.001	0.14

[1] For each row, values for Land Use Value types with the same letter are statistically similar and values with different letters are significantly different.

Table 5. The percent of landowners and each Land Use Value type by land use practice.[1,2]

	Land Use Value Types						
Sample	*Humans First*	*Nature First*	*Inter-connected*	*Dis-connected*	*F-Ratio*	*P-Value*	*Eta*
Rotate crops							
91%	94%[a]	89%[b]	93%[ab]	90%[ab]	2.94	0.032	0.07
Herbicides							
89%	93%[a]	86%[b]	89%[ab]	90%[ab]	5.36	0.001	0.07
Conservation tillage							
87%	89%[a]	85%[ab]	90%[a]	82%[b]	5.00	0.002	0.07
Control run-off							
85%	83%[ac]	85%[abc]	89%[b]	83%[ac]	3.10	0.026	0.07
Soil testing							
82%	88%[a]	77%[b]	83%[ab]	79%[b]	7.63	<0.001	0.11
Shelterbelts							
79%	74%[a]	85%[b]	77%[a]	76%[a]	7.35	<0.001	0.10
Insecticides							
72%	81%[a]	63%[b]	75%[ac]	69%[bc]	15.45	<0.001	0.15
Provide water tanks for livestock							
69%	70%[ab]	69%[ab]	74%[a]	63%[b]	3.58	0.014	0.09
Allow free hunting							
67%	65%[ab]	64%[a]	71%[b]	67%[ab]	2.90	0.034	0.07
Maintain wetlands for wildlife							
66%	52%[a]	75%[b]	69%[bc]	65%[c]	18.84	<0.001	0.18
Integrated pest management							
64%	71%[ac]	58%[b]	67%[c]	61%[bc]	8.12	<0.001	0.11
Maintain grasslands for wildlife							
62%	51%[a]	71%[b]	64%[bc]	61%[c]	13.48	<0.001	0.15
Cover crops							
57%	55%[a]	60%[a]	58%[a]	55%[a]	1.41	0.239	0.05
Filter strips							
52%	48%[a]	55%[a]	53%[a]	54%[a]	1.55	0.199	0.05
Lethal wildlife control							
52%	52%[a]	52%[a]	53%[a]	50%[a]	0.27	0.848	0.02
Plant food plots							
49%	37%[a]	54%[b]	51%[b]	51%[b]	10.79	<0.001	0.13
Establish and restore wetlands							
43%	31%[a]	55%[b]	45%[c]	39%[ac]	17.13	<0.001	0.18
Non-lethal wildlife control							
40%	36%[a]	44%[a]	41%[a]	37%[a]	2.65	0.048	0.07
Plant pollinator seeds							
34%	27%[a]	42%[b]	36%[abc]	27%[ac]	10.00	<0.001	0.14

Protect milkweed							
34%	24%[a]	45%[b]	32%[a]	30%[a]	16.03	<0.001	0.17
Written grazing plan							
23%	14%[a]	25%[bc]	30%[b]	19%[ac]	9.56	<0.001	0.14
Convert grasslands to crops							
21%	21%[a]	18%[a]	24%[a]	20%[a]	1.92	0.124	0.05
Convert wetlands to crops							
17%	21%[a]	14%[b]	15%[ab]	18%[ab]	4.53	0.004	0.08
Provide hunting access for a fee							
10%	10%[a]	8%[a]	12%[a]	9%[a]	1.13	0.335	0.04

[1] Values were analyzed as the proportion of the sample participating in the activity, as defined.

[2] For each row, values for Land Use Value types with the same letter are statistically similar and values with different letters are significantly different.

9. Figure Legend

Figure 1. A visual representation of the 4 Land Use Value types (Sweikert & Gigliotti 2017).

Figure 2. The percent of landowners in each LUV type by the amount of land owned ($\chi^2 = 42.15$, $df = 18$, $p = 0.001$, Cramer's $V = 0.076$).

10. Figures

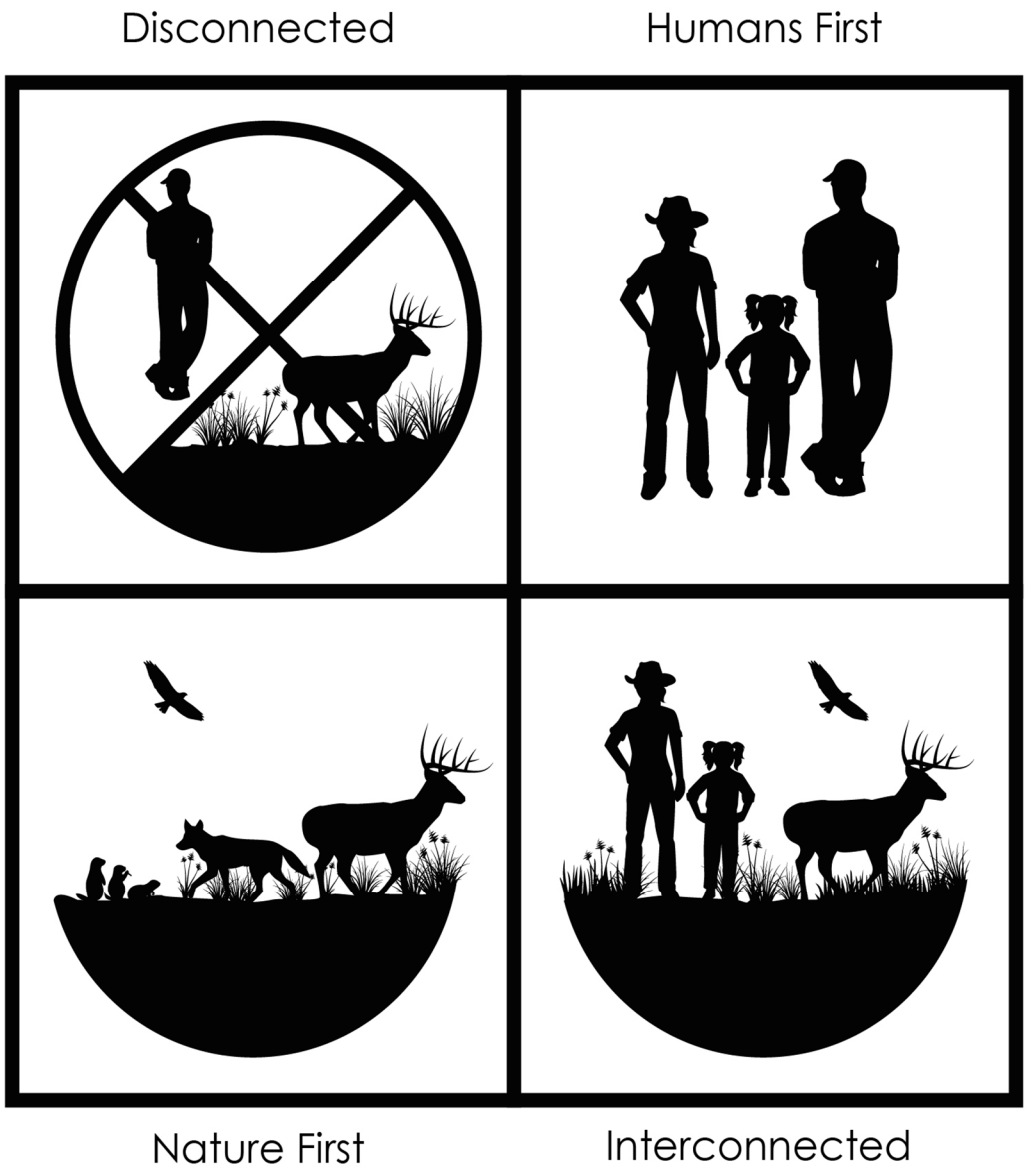

Figure 1. A visual representation of the 4 Land Use Value types (Sweikert & Gigliotti 2017).

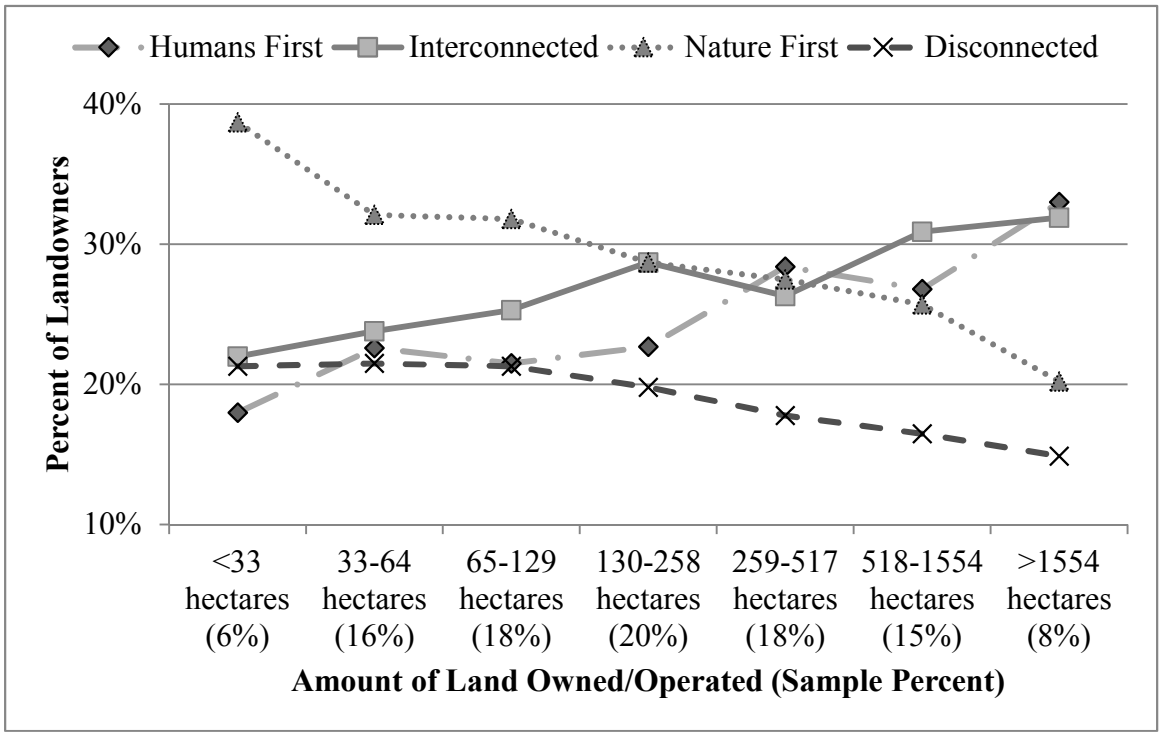

Figure 2. The percent of landowners in each LUV type by the amount of land owned (χ^2 = 42.15, *df* = 18, *p* = 0.001, Cramer's *V* = 0.08).

CHAPTER 4: EVALUATING THE ROLE OF FARM BILL CONSERVATION PROGRAM PARTICIPATION IN CONSERVING AMERICA'S GRASSLANDS

11. Abstract

The majority of the grassland ecosystem in the United States is privately owned and used for agriculture. Yet, grasslands are one of the most imperiled ecosystems in the world. Conversion of grasslands to row crops is expanding, fueled by commodity price increases, technological improvements, and agricultural policy. The U.S. government primarily uses voluntary incentive-based conservation programs to address the environmental impacts of agriculture and encourage conservation on private land. I surveyed private landowners in the Plains and Prairie Potholes Ecoregion (PPPE), one of America's most at-risk grassland areas, about land use, environmental attitudes and values, and participation in Farm Bill conservation programs. Agricultural landowners with larger land holdings, who value hunting, and have positive environmental attitudes, values, and resulting behaviors, were more likely to participate in a program. Finances and a desire for autonomy limited participation. Surprisingly, program participants had less land in grass than nonparticipants and were more likely to convert planted grasslands and/or wetlands to row crops. These findings of an inverse relationship between participation in a Farm Bill conservation program and perpetuity of grasslands, signal the need for further investigation of this relationship as well as additional tools to conserve the PPPE.

12. Keywords

Agriculture, Conservation programs, Grassland, Land use conversion, US Farm Bill

13. Introduction

Grasslands provide ecosystem services including livestock and crop production, wildlife habitat, wildlife viewing and hunting and fishing opportunities, soil and water quality improvements, carbon sequestration, and weather improvement (Sala and Paruelo, 1997). The Plains and Prairie Potholes Ecoregion (PPPE), a grassland and wetland ecosystem defined by the U.S. Fish and Wildlife Service and lying in the states of Iowa, Minnesota, Montana, Nebraska, North Dakota, and South Dakota, is additionally noted for supporting large populations of migrating bird species (Doherty et al., 2013; PPPLCC, n.d.). Ensuring the unaltered persistence of these grassland ecosystem services is becoming more difficult and the need to improve conservation efforts, more urgent.

Grasslands are one of the most critically imperiled ecosystems on the planet (Hoekstra et al., 2005). Since European colonization, 50-70% of grasslands in the contiguous U.S. have been converted to human dominated uses, primarily agriculture (Hoekstra et al., 2005; Samson et al., 2004; US Department of Agriculture, 2010). Conversion at this scale jeopardizes the ecosystem's function and the services it provides (Chapin et al., 2000; Gascoigne et al., 2011). Recent conversion rates have surged, driven by growing demand for agricultural commodities, improvements in technology, and government agriculture policies (Lark et al., 2015; U.S. Government Accountability Office, 2007). Half of all

grasslands converted in the U.S. from 1997 to 2007 were located in the PPPE (Claassen et al., 2011; Wright and Wimberly, 2013).

The primary comprehensive U.S. agriculture policy, known commonly as the Farm Bill, aims to secure the agriculture industry through payments of income and price support for certain crops, crop insurance premium subsidies, and disaster assistance (Claassen, 2014). The Farm Bill of 2014 also attempts to address the environmental impact of agriculture by requiring conservation compliance of highly erodible land and wetland from farm program payment recipients (North American Bird Conservation Initiative, U.S. Committee, 2015). Additionally, the 2014 Farm Bill continues voluntary programs to incentivize land easements and retirement and adoption of conservation practices on working lands (Reimer, 2015). The largest and oldest Farm Bill conservation program is the Conservation Reserve Program, which offers landowners 10-15 year contracts of annual payments to retire land by planting it in cover crops like grass (North American Bird Conservation Initiative, U.S. Committee, 2015). The Farm Bill conservation provisions are the primary methods used by the U.S. government to address environmental needs of private land.

Despite research demonstrating the benefits of the Farm Bill to fish and wildlife species, more recent studies demonstrate the Farm Bill's economic policies work at odds with its conservation programs by decreasing risk and increasing profitability of agriculture, and encouraging conversion of grassland to cropland, especially of marginal land like that in the PPPE (Burger Jr, 2006; Claassen et al., 2011; Gray and Teels, 2006; U.S.

Government Accountability Office, 2007; Wright and Wimberly, 2013). The 2014 Farm Bill attempts to resolve this issue by including an obligatory "Sodsaver" provision for the PPPE states of Iowa, Minnesota, Montana, Nebraska, North Dakota, and South Dakota, disincentivizing conversion of native grassland to row crops by reducing insurance premium subsidies by 50% for the first four years on newly converted land (Lark et al., 2015; Miao et al., 2016).

While it is too soon to realize the impact of Sodsaver on conversion rates, economic simulations predict its benefits will be limited to a market with mediocre commodity prices (Miao et al., 2016). Since future commodity prices are unknown and functioning of the PPPE is already in jeopardy, conservation professionals need to evaluate their tool kit including the utility of Farm Bill conservation programs to address the conservation needs of the PPPE (Higgins et al., 2002; Williams, 2014).

This research seeks to answer the question: what role do U.S. Farm Bill conservation programs play in conserving the PPPE's grasslands? Furthermore, I attempt to describe the types of PPPE landowners who enroll in a conservation program and their reasons for their choice.

I hypothesize:

1. People who enroll in a Farm Bill conservation program have stronger positive environmental attitudes, values, and behaviors than those not enrolled.

2. Positive environmental attitudes and values drive enrollment in a Farm Bill conservation program and finance is the primary obstacle to enrollment.
3. People who enroll in a Farm Bill conservation program are more likely to conserve grasslands than those not enrolled.

14. Material and Methods

4.1 Survey mailing

I surveyed private landowners in the Plains and Prairie Potholes region of Minnesota (MN) (N = 3,000), North Dakota (ND) (N = 4,000), and South Dakota (SD) (N = 4,000), from 31 December 2015 through 28 June 2016, in collaboration with the Minnesota Department of Natural Resources (MNDNR), the North Dakota Game and Fish Department (NDGF), and South Dakota Department of Game, Fish, and Parks (SDGFP). The population was defined as individuals owning more than 80 acres in MN, 40 acres in ND, and 100 acres in SD. The MNDNR staff randomly selected 3,000 individuals and the NDGF staff randomly selected 2,000 individuals each, from counties east and west of the Missouri River, from lists of private landowners maintained by each department. SDGFP staff purchased a database of private landowners from a marketing company (www.GoLeads.com) and randomly selected 2,000 individuals each, from counties east and west of the Missouri River.

Data were collected via mail surveys following a modified Dillman method (Dillman, 2000). The MN, ND, and SD questionnaires, reminder postcards, and second mailing of questionnaires were mailed from the MNDNR, NDGF headquarters, and South Dakota State University, respectively. Questionnaires were 12-pages long for ND and SD, and 11-pages for MN, including a cover page and a comment section. The mailing included a postage-paid business-reply envelope for return of completed surveys or blank surveys to indicate "decline to participate." All survey mailings included a cover letter that served to obtain informed consent. The cover letter explained the study's purpose, how the data would be used, that data would be confidential and secure, participation was voluntary, when and where the results would be available, and provided contact information for the researchers.

4.2 Questionnaire contents

The questionnaire included measures of attitudes, motivations, behaviors, and demographics. The demographic questions asked the person's age, gender, occupation (farmer, rancher, both, neither), work status (full-time, part-time, retired), size of land owned/operated, number of years farming and/or ranching, and percent of land used in 2015 for planted commodities, grassland/pasture, enrolled in conservation programs, and remaining lands. For behavior questions, I asked whether the individual had enrolled in a U.S. Farm Bill conservation program, whether they were a hunter, about their use of 22 land use practices (i.e., done in the past, currently do and/or plan to do), such as soil testing, insecticides, planting trees and shrubs, managing grasslands for wildlife, whether,

in the past 10 years (2005-2015), they had converted grassland to crops, if so, had they converted virgin sod and/or planted grass like that in a Farm Bill conservation program (FBCP, e.g. Conservation Reserve Program), and/or had they drained, moved, or minimized wet areas on their land.

For attitude and motivation questions, I asked about the importance of different reasons ($N = 20$) for the decision to use various land use practices such as providing shelter for wildlife, preventing soil erosion, improving productivity, and increasing plant diversity; the importance of different wildlife categories ($N = 9$) such as deer, pheasant, and coyotes; the importance of reasons for enrolling in a conservation program ($N = 14$) such as improve water quality, provide habitat for game species, and financial compensation; the importance of reasons for not enrolling or no longer participating in a conservation program ($N = 10$) such as not having land that qualifies and decreases options for using my property. Importance was measured on a 4-point scale (0 = not important, 1 = slightly important, 2 = moderately, and 3 = very). In analysis of reasons for not participating in a conservation program, I selected only those who indicated that they owned/operated land that could qualify for a FBCP. I asked landowners about the importance of hunting on a 5-point scale (0 = not important, 1 = slightly, 2 = moderately, 3 = very, 4 = most). I also asked participants about their level of disagreement to agreement, on a 7-point scale (1 = strongly disagree to 7 = strong agree), with statements used to develop the Land Use Value scale, which measures the conservation land use values of farmers and ranchers (Sweikert and Gigliotti, 2017). The Land Use Value scale has two dimensions: Human-Centered and Nature-Centered and identifies four types of values: the “Humans First”

type has high human-centered and low nature-centered scores, "Nature First" has high nature-centered and low human-centered scores, "Interconnected" has high scores on both nature and human centered, and "Disconnected" has low scores on both.

4.3 Nonresponse survey

At the completion of the survey I sent a nonresponse questionnaire and a new cover letter to all nonrespondents from MN (N = 1,588) and ND (N = 2,483) and 1,000 randomly selected non-respondents from SD. In the questionnaire, I included the Land Use Value scale, some demographic questions (amount of land owned, enrollment in a U.S. Farm Bill Conservation Program, county residence, age, and gender) and collected data about the individual's eligibility for the survey (i.e., was the recipient deceased, no longer farmed or ranched, or no longer owned land).

4.4 Statistics

I used analysis of variance and chi-square tests to look for relationships between an individual's history of enrollment in a conservation program and their attitude, motivation, behavior, and demographic variables. Relationships were interpreted as significant at $\alpha < 0.05$. Effect size interpretations for phi (ϕ) were 0.10 – 0.29 = "small" or "minimal," 0.30 – 0.49 = "medium" or "typical," and ≥ 0.50 = "large" or "substantial," and Cramer's V effect sizes were calculated using the phi interpretations divided by the square root of *df* (Cohen, 1988; Vaske, 2008). Effect sizes for eta were interpreted as 0.10

– 0.24 = “small” or “minimal,” 0.25 – 0.36 = “medium” or “typical,” and ≥ 0.37 = “large” or “substantial.”

15. Results

15.1 Survey mailing results

Removing undeliverable questionnaires and ineligible addresses, I estimated 2,792 eligible participants for MN, 3,487 for ND, and 3,027 for SD. I received 937 completed MN survey questionnaires (34%) and 178 nonresponse questionnaires, 770 from the ND survey (22%) with 180 nonresponse questionnaires, and 942 from SD (31%) with 131 nonresponse questionnaires. Overall, a higher percent of non-respondents owned/operated the smaller categories of land than respondents (Figure 1; $\chi^2 = 51.52$, $df = 6$, $P \leq 0.001$, Cramer’s $V = 0.14$), a slightly higher percent of non-respondents were female (20% vs. 15%) ($\chi^2 = 8.17$, $df = 1$, $P = 0.004$, $\phi = 0.05$), and non-respondents were slightly younger (Mean age: 65 vs. 67), while significant the difference is inconsequential (ANOVA F (1; 3010) = 9.15, $P = 0.003$, $\eta = 0.06$). However, for my dependent variable, enrollment in a Farm Bill conservation program, there was no significant difference between respondents and the nonresponse survey ($\chi^2 = 0.01$, $df = 1$, $P = 0.931$, $\phi = -0.00$). Also, the proportions of Land Use Values types for respondents and non-respondents were not significantly different ($\chi^2 = 6.35$, $df = 3$, $P = 0.096$, Cramer’s $V = 0.05$). I believe that non-response bias is not an important problem given the small differences detected, but acknowledge that a significant response bias could still exist (Groves, 2006).

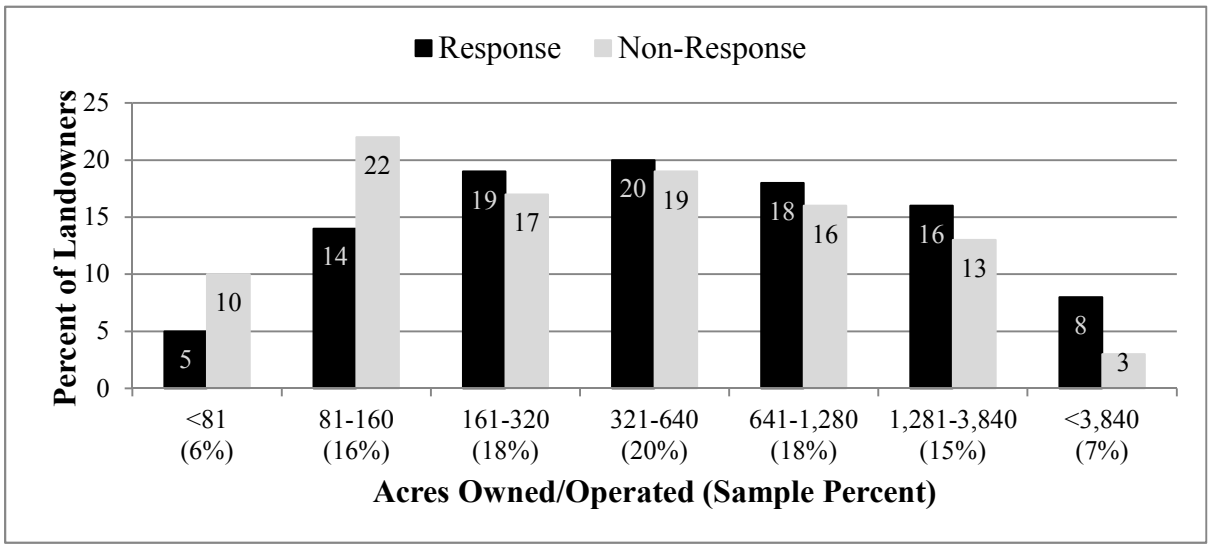

Figure 1. Percent land owned/operated, comparing respondents from the original survey to the non-response survey ($\chi^2 = 51.52$, $df = 6$, $P \leq 0.001$, Cramer's $V = 0.14$).

15.2 Description of U.S. Farm Bill conservation program participants

Participation in a U.S. Farm Bill conservation program (FBCP) was significantly different for the three states: 62% of MN respondents had enrolled in a FBCP, 44% of the ND sample, and 56% of the SD sample ($\chi^2 = 61.90$, $df = 2$, $P \leq 0.001$, Cramer's $V = 0.15$). The sample was comprised of self-identified farmers (56%), ranchers (11%), landowners who identified as both farmer and rancher (9%), and non-agricultural landowners (24%). Fifty-nine percent of farmers, 54% of ranchers, 58% farmer/ranchers, and 47% of non-agricultural landowners were enrolled in a FBCP ($\chi^2 = 22.32$, $df = 3$, $P \leq 0.001$, Cramer's $V = 0.10$). The main difference in enrollment was between agricultural landowners (59% enrollment) and non-agricultural landowners (47% enrollment) ($\chi^2 = 20.02$, $df = 1$, $P \leq 0.001$, $\phi = -0.10$). Forty six percent of agricultural landowners worked in agriculture full-time, 22% part-time, and 33% were retired. Work status was not

significantly related to enrollment in a FBCP with full-time workers reporting 60% enrollment, part-time reporting 58%, and retired reporting 57% ($\chi^2 = 1.25$, $df = 2$, $P = 0.536$, Cramer's $V = 0.03$). Similarly, there was no significant relationship between an individual's years of experience with agriculture and enrollment in a FBCP ($\chi^2 = 5.54$, $df = 4$, $P = 0.237$, Cramer's $V = 0.05$).

Landowners enrolled in a FBCP were slightly younger ($M = 65.6$) than those not enrolled ($M = 66.7$), although the difference was inconsequential (ANOVA F (1; 2831) = 4.96, $P = 0.026$, $\eta = 0.04$) and males reported higher participation in a FBCP (56%) than females (47%) ($\chi^2 = 12.23$, $df = 1$, $P \leq 0.001 = 0.002$, $\phi = -0.07$). Enrollment in a FBCP significantly increased with the amount of land owned/operated (Figure 2; $\chi^2 = 125.88$, $df = 6$, $P \leq 0.001$, Cramer's $V = 0.22$).

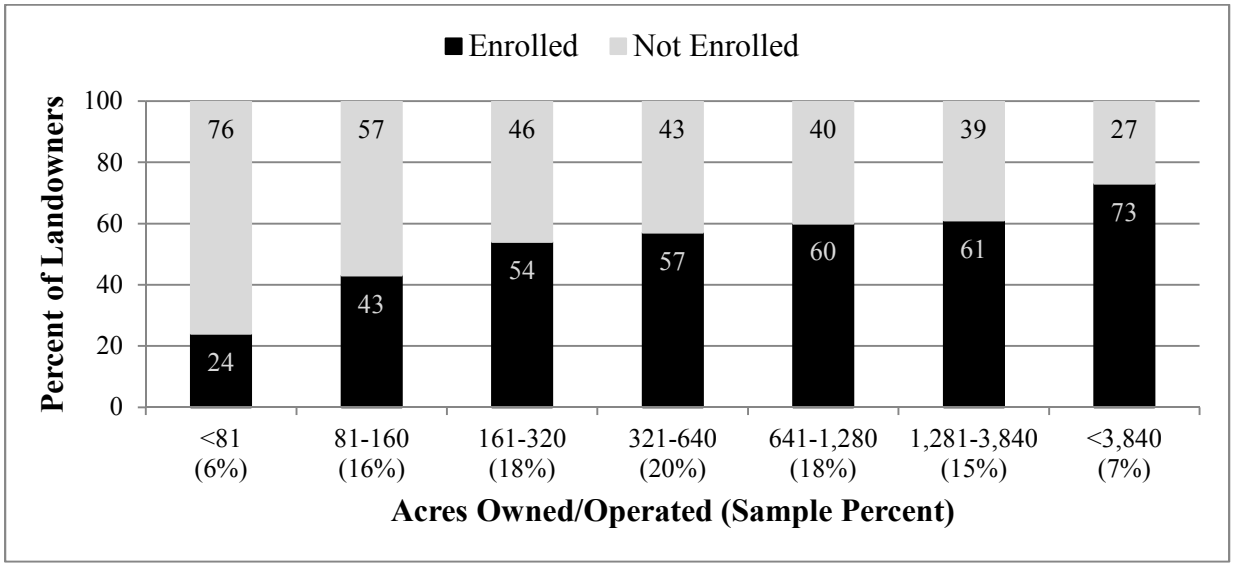

Figure 2. Percent of landowners enrolled and not enrolled in a U.S. Farm Bill conservation program based on amount of land owned/operated in MN, ND, and SD ($\chi^2 = 125.88$, $df = 6$, $P \leq 0.001$, Cramer's $V = 0.22$).

In the sample, 56% of respondents from MN identified as hunters, 58% of ND, and 54% of SD. Fifty-eight percent of hunters were enrolled in a FBCP and significantly more enrollees (60%) identified as a hunter ($\chi^2 = 15.27$, $df = 1$, $P \leq 0.001$, $\phi = 0.08$). Landowners' rating of the importance of hunting, compared to other types of recreation, had a positive relationship with percent enrollment in a FBCP (Figure 3; $\chi^2 = 36.93$, $df = 4$, $P \leq 0.001$, Cramer's $V = 0.15$).

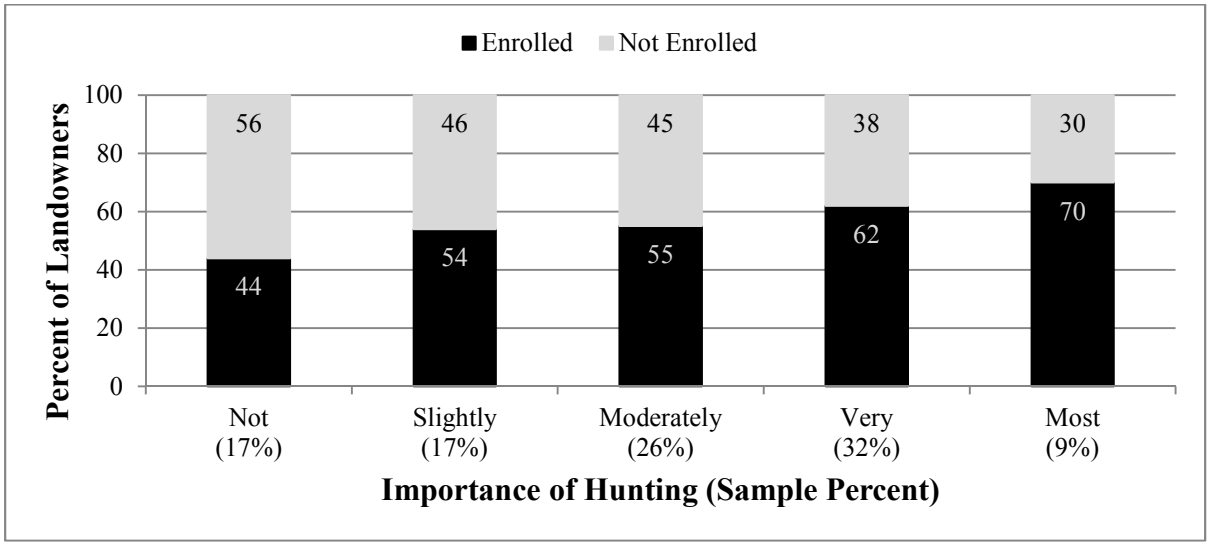

Figure 3. Percent of landowners enrolled and not enrolled in a U.S. Farm Bill conservation program in MN, ND, and SD, analyzed by their rating of the importance of hunting ($\chi^2 = 36.93$, $df = 4$, $P \leq 0.001$, Cramer's $V = 0.15$).

Enrollment had a significant relationship with the Land Use Value types with 50% of Humans First enrolled in a FBCP, 61% of Nature First enrolled, 54% of Interconnected enrolled, and 56% of Disconnected enrolled ($\chi^2 = 18.21$, $df = 3$, $P \leq 0.001$, Cramer's V = 0.08). Landowners who enrolled in a FBCP had significantly higher participation in 19 of 22 land use practices, compared to those not enrolled, however, effect sizes were small for several practices (Table 1). Some of the largest differences in participation between

landowners enrolled and not enrolled were for practices related to wildlife, soil, wetlands, and riparian areas.

Land Use Practices	Enrolled	Not Enrolled	χ^2	*P*-value	Phi
Use herbicides	91%	87%	9.26	0.002	0.06
Use conservation tillage practices	89%	82%	17.74	< 0.001	0.09
Control agricultural run-off	88%	79%	30.50	< 0.001	0.12
Conduct soil testing	84%	76%	20.83	< 0.001	0.10
Plant trees and shrubs (e.g., shelter belts)	84%	69%	63.04	< 0.001	0.17
Use insecticides	73%	68%	7.73	0.005	0.06
Manage/maintain wetlands for wildlife	73%	52%	84.33	< 0.001	0.21
Manage grasslands for wildlife	72%	45%	153.62	< 0.001	0.28
Provide livestock with water tanks	70%	68%	0.44	0.506	0.02
Allow free reasonable public hunting	68%	64%	4.55	0.330	0.05
Use integrated pest management	67%	57%	22.30	< 0.001	0.11
Plant cover crops	61%	48%	30.20	< 0.001	0.12
Plant and maintain filter strips	60%	39%	79.74	< 0.001	0.21
Plant food plots	58%	32%	128.81	< 0.001	0.26
Use lethal methods to protect/reduce property damage from wildlife	55%	46%	12.48	< 0.001	0.08
Establish or restore wetlands	51%	31%	67.61	< 0.001	0.20
Plant pollinator seed mixes	40%	23%	62.80	< 0.001	0.19
Use non-lethal methods to protect/reduce property damage from wildlife	39%	38%	0.09	0.762	0.01
Use a written grazing management plan	28%	14%	39.36	< 0.001	0.16
Provide hunting access for a fee	12%	7%	14.49	< 0.001	0.08

Table 1. Participation in land use practices for landowners enrolled and not enrolled in a U.S. Farm Bill conservation program in MN, ND, and SD.

Landowners enrolled in a FBCP gave significantly higher importance ratings to seven of nine wildlife categories, but the effect sizes were “small” or “minimum” (Table 2) (Cohen, 1988; Vaske, 2008). Landowners rated pheasant and grouse the most important wildlife category for land use decisions, with the largest effect size, out of nine

categories. The other two categories that included game, such as deer, elk, pronghorn, and fish, had the second and third largest effect sizes. Only predators (e.g., coyotes, mountain lions) and non-game mammals (e.g., skunks) had no significant relationship with enrollment in a FBCP by a landowner.

Wildlife Categories	Enrolled	Not Enrolled	F-value	*P*-value	Eta
Pheasant, grouse, etc.	3.2	2.8	97.61	≤ 0.001	0.20
Bees	2.9	2.7	18.54	≤ 0.001	0.09
Monarchs and other butterflies	2.8	2.5	27.20	≤ 0.001	0.11
Deer, elk, pronghorn, etc.	2.8	2.4	48.94	≤ 0.001	0.14
Hawks, eagles, owls, etc.	2.3	2.2	4.32	0.038	0.04
Other insects	2.0	1.9	7.44	0.006	0.06
Fish, reptiles, amphibians	2.0	1.7	26.52	≤ 0.001	0.12
Coyotes, foxes, mountain lions, etc.	1.8	1.8	0.60	0.438	0.02
Other non-game mammals	1.7	1.8	0.05	0.832	0.00

Table 2. Mean rating of importance of various wildlife categories to land use decisions for landowners enrolled and not enrolled in a U.S. Farm Bill Conservation Program in MN, ND, and SD.

Landowners rating of the importance of 20 reasons to their land use decisions gave the highest ratings to reasons associated with soil and water quality, unwanted plants, and productivity (Table 3). Sixteen reasons were significantly related to enrollment in a FBCP, however, effect sizes were “small” or “minimum” (Cohen, 1988; Vaske, 2008). The largest differences between landowners enrolled and not enrolled in a FBCP were for reasons generally related to wildlife.

Reason for Land Use	Enrolled	Not Enrolled	F-value	*P*-value	Eta
Prevent soil erosion	3.6	3.5	12.10	≤ 0.001	0.07
Remove and control unwanted	3.5	3.4	6.29	0.012	0.05

plants					
Improve productivity	3.4	3.4	0.06	0.803	0.01
Protect water quality	3.4	3.3	11.73	0.001	0.07
Produce and grow agricultural crops	3.3	3.3	0.28	0.598	0.01
Provide shelter for wildlife	3.1	2.7	86.96	≤ 0.001	0.19
Provide habitat for wildlife	3.1	2.7	94.88	≤ 0.001	0.20
Control insects	2.9	2.9	0.89	0.346	0.02
Encourage quick vegetation recovery	2.9	2.8	13.15	≤ 0.001	0.08
Provide food for wildlife	2.9	2.5	90.84	≤ 0.001	0.20
Financial considerations	2.8	2.6	31.04	≤ 0.001	0.12
Attract and feed bees and butterflies	2.8	2.6	26.63	≤ 0.001	0.11
Increase plant diversity	2.8	2.6	21.76	≤ 0.001	0.10
Provide water for wildlife	2.7	2.4	39.78	≤ 0.001	0.13
Control wildlife	2.6	2.4	36.30	≤ 0.001	0.13
Raise and produce livestock	2.5	2.6	4.48	0.034	0.04
Produce and grow feedstock	2.5	2.5	0.60	0.440	0.02
Protect riparian vegetation	2.4	2.1	47.17	≤ 0.001	0.15
Increase grazing season length	2.1	2.3	3.98	0.046	0.04
Protect fisheries	2.1	1.8	23.96	≤ 0.001	0.10

Table 3. Landowners' mean rating of the importance of reasons for land use practices for those enrolled and not enrolled in a U.S. Farm Bill conservation program in MN, ND, and SD.

15.3 *Reasons for and against participating in a U.S. Farm Bill conservation*

Landowners' ratings of the importance of 14 reasons to their decision to enroll in a FBCP gave the top two highest ratings to financial compensation and improve habitat for game (Table 4). Twelve of 14 reasons for participating were significantly related to enrollment. The two reasons not statistically significant were "tax credits" and "provide habitat for monarch butterflies." The largest difference in importance between enrolled and not enrolled landowners was "improve habitat for game."

Reason for Enrolling	Enrolled	Not	F-value	*P*-value	Eta

	Enrolled				
Financial Compensation	3.0	2.5	75.44	≤ 0.001	0.21
Improve habitat for game	3.0	2.3	130.87	≤ 0.001	0.27
Improve water quality	3.0	2.7	25.24	≤ 0.001	0.12
Improve soil quality	2.9	2.6	24.31	≤ 0.001	0.12
Provide habitat for upland birds	2.8	2.3	61.42	≤ 0.001	0.19
Support native grass plantings	2.7	2.3	38.90	≤ 0.001	0.15
Provide habitat for pollinators	2.6	2.4	20.25	≤ 0.001	0.11
Improve habitat for non-game	2.5	2.1	39.08	≤ 0.001	0.15
Increase plant diversity	2.4	2.1	20.09	≤ 0.001	0.11
Protect endangered species	2.4	2.2	6.22	0.013	0.06
Provide river buffer strips	2.3	1.9	29.17	≤ 0.001	0.13
Tax credits	2.2	2.3	2.25	0.134	0.04
Provide habitat for monarch butterflies	2.1	2.1	2.04	0.154	0.04
Provide wet areas	2.2	1.8	31.72	≤ 0.001	0.14

Table 4. Landowners' mean rating of the importance of reasons for enrolling in a U.S. Farm Bill Conservation Program.

Landowners also rated the importance of nine reasons to their decision of not enrolling or no longer participating in a FBCP, five of which had a significant relationship with enrollment (Table 5). Landowners with a history of enrollment gave their highest rating to "financial incentives are not high enough" and landowners not enrolled rated "decreases my options for using my property" the highest. Overall, landowners (enrolled and not enrolled) were relatively similar in their evaluations of reasons for not or no longer participating in a FBCP.

Reason for Not Enrolling	Enrolled	Not Enrolled	F-value	*P*-value	Eta
The financial incentives are not high enough	2.4	2.2	5.23	0.022	0.08
Decreases my options for using my property	2.3	2.6	15.63	≤ 0.001	0.13
The length of the agreement (in years) is too long	2.0	1.9	0.20	0.652	0.02
Do not want to sign a contract	1.7	2.0	15.57	≤ 0.001	0.13

with the government					
The programs are too complicated and confusing	1.8	1.8	0.00	0.960	0.00
Increases my expenses	1.7	1.8	2.59	0.108	0.05
Takes a lot of time and effort	1.7	1.8	0.02	0.878	0.01
Don't want to work with a conservation partner (e.g. Ducks Unlimited) to enroll my land	1.6	1.8	11.41	0.001	0.11
There are not enough enrollment opportunities	1.7	1.5	10.29	0.001	0.11

Table 5. Landowners' mean rating of the importance of reasons for not enrolling or no longer participating in a U.S. Farm Bill Conservation Program.

15.4 U.S. Farm Bill conservation program participation and grasslands

After removing the percent of land reported as enrolled in a conservation program, there was a significant difference between land use of those enrolled and not enrolled in a FBCP (Figure 4). Enrollees reported significantly more land planted with commodities and leftover land than non-enrollees and significantly less land in grass; however, effect sizes were very small.

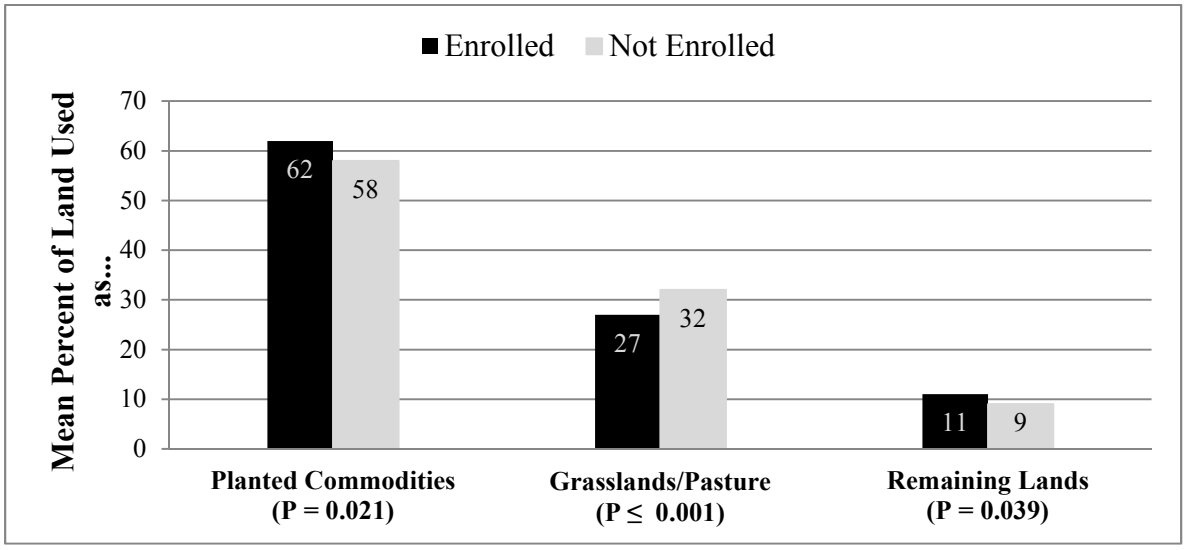

Figure 4. Mean percent of land used for planted commodities, (ANOVA F (1; 2085) = 5.33, η = 0.05), grasslands/pasture, (ANOVA F (1; 2085) = 13.06, η = 0.08), and remaining lands (ANOVA F (1; 2085) = 4.25, η = 0.05) in 2015, by landowners enrolled and not enrolled in a U.S. Farm Bill conservation program in MN, ND, and SD.

Approximately 17% of landowners reported they had drained, removed, or minimized wet areas on their land and the majority of them (63%) had been enrolled in a FBCP (Figure 5). About 20% of landowners converted grassland to row crops and 67% of the landowners who converted grass had also enrolled in a FBCP. Furthermore, 72% of people who converted grass converted planted grass such as Conservation Reserve Program grass, of whom 72% were enrolled in a FBCP. Forty three percent of landowners who converted grass converted virgin sod, of whom 61% were enrolled in a FBCP but the relationship was not significant.

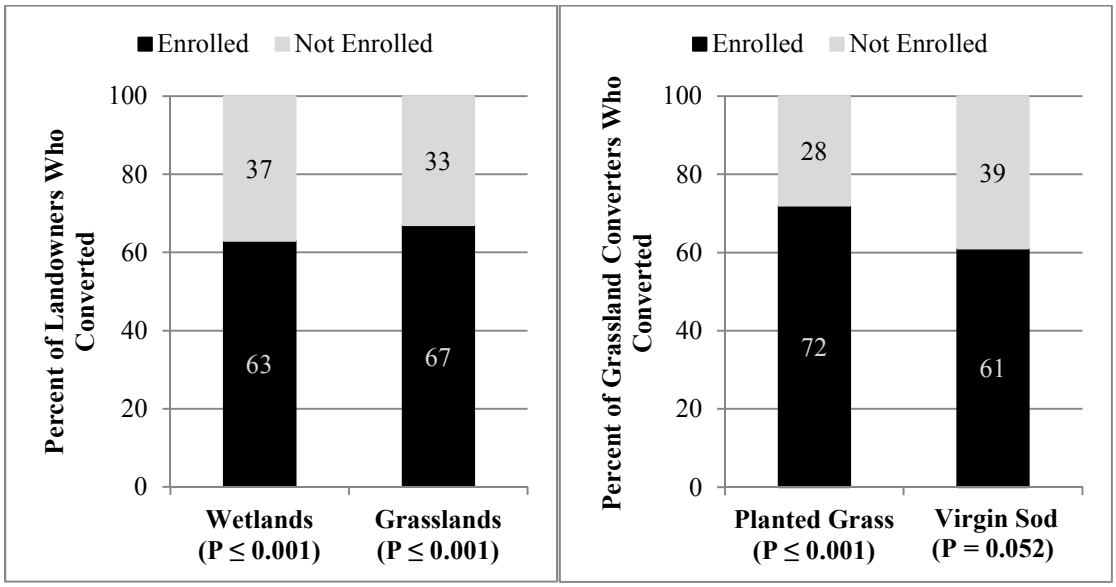

Figure 5. Percent of landowners who removed, drained, or minimized wetlands, (χ^2 = 14.49, df = 1, $P \leq 0.001$, ϕ = 0.08), and/or converted grasslands, (χ^2 = 33.31, df = 1, $P \leq 0.001$, ϕ = 0.12), on their land and the percent of grassland converters who converted planted grass, (χ^2 = 13.21, df = 1, $P \leq 0.001$, ϕ = 0.17), and virgin sod, (χ^2 = 3.76, df = 1, P = 0.052, ϕ = -0.09), (2005-2015) in MN, ND, and SD and were enrolled or not enrolled in a U.S. Farm Bill conservation program.

16. Discussion and Conclusions

The Farm Bill conservation programs are the primary tools used by the U.S. government to attain conservation objectives on private agricultural land. With an increasing threat of losing the ecological function of grasslands and the ecosystem services they provide, it is important to understand who participates in FBCPs, why they participate, and what role FBCPs play in promoting conservation behaviors and conserving grasslands. In the Plains and Prairie Potholes Ecoregion, one of United States' most-at-risk grasslands, FBCP enrollees reported stronger environmental, wildlife, and hunting values, attitudes, and behaviors, but they also reported a lower likelihood of having and maintaining land in grass, than non-enrollees.

Enrollment in FBCPs increased with the amount of land owned/operated. These results are consistent with other studies demonstrating that larger land holdings can provide more opportunities for qualifying for FBCPs and large-scale landowners may find it easier to participate in a FBCP because they can afford to take more risks (Fortmann and Huntsinger, 1989). The U.S. Department of Agriculture's annual farm reports show a trend of an increasing number of large-scale farms (U.S. Department of Agriculture and National Agricultural Statistics Service, 2016, 2015, 2014, 2013, 2012). This suggests that landowner interest in FBCPs will increase as landowners explore opportunities to diversify land use practices, including participation in FBCP, to maximize profitability.

Examination of participation in land use practices, importance of reasons for land use practice choice, and reasons for participating in a FBCP demonstrated that FBCP

enrollees reported significantly higher participation in environmentally-friendly practices, generally motivated by wildlife reasons, compared to non-enrollees. These results support my first and second hypotheses and the research of others, which is that people who participate in a government conservation program are more likely to have strong positive environmental attitudes (Henderson et al., 2014; Reimer and Prokopy, 2014; Sorice et al., 2011).

In addition to finding that FBCP enrollees are environmentally inclined, they also reported significantly higher importance of wildlife species that can be harvested to their land use decisions, hunting, and improving habitat for game as a reason for participating in a FBCP than non-enrollees. My results indicate, people who enroll in a FBCP value hunting as a recreational activity significantly more than people who are not enrolled. This supports the literature's conclusions that hunting is an important recreation for those who participate in a FBCP (Allen and Haufler, 2005; Willcox and Giuliano, 2011).

In the evaluation of reasons for participating in a FBCP I demonstrated that "Financial Compensation" is the most important reason for enrolling in a FBCP and "Financial incentives are not high enough" is the most important reason for not participating for enrollees, which supports my second hypothesis. These findings suggests that the biggest barrier to implementing conservation practices is insufficient funds and are consistent with the research of others (Lynne et al., 1988; Macdonald and Johnson, 2000; Reimer and Prokopy, 2014; Sorice et al., 2011). Participants reported finances as the most

important factor influencing their participation in a program designed to alleviate the financial constraints of conservation.

Non-enrollees reported their primary reason for not participating in a FBCP was that enrollment "Decreases my options for using my property." Other researchers also have found that a major deterrent to participation in a government conservation program is the perception that enrolling in such a program requires sacrificing freedom of land use (Brook et al., 2003; Reading et al., 1994; Reimer and Prokopy, 2014). Policy makers have addressed the fear of loss of control with endangered species recovery efforts through the development of the Safe Harbor program which guarantees no additional regulatory requirements for land voluntarily managed to enhance endangered or threatened species habitat (Sheldon, 1997). To maximize enrollment in FBCPs, policy makers could address this fear of loss of control in a similar fashion to how it was addressed for the Endangered Species Act.

Landowners who reported having converted grasslands and/or diminished wetlands were more likely to have enrolled in a FBCP, which does not support my third hypothesis. Enrollees have less land in grass, more land in crop production and remaining lands, and, of the people who converted, were more likely to diminish wetlands and/or convert planted grasslands than non-enrollees. This suggests my findings may add additional support to studies that demonstrated Farm Bill agriculture payment programs encourage conversion of grassland to crops (Claassen et al., 2011; U.S. Government Accountability Office, 2007). FBCP enrollees may be more likely than non-enrollees to receive Farm

Bill agriculture payments and timing could be a factor explaining my results, with enrollees participating in a FBCP when commodity prices are mediocre and converting land to crop production when prices are high or low, as shown in the literature (Feng et al., 2013; Miao et al., 2016; Wang et al., 2017; Wimberly et al., 2017). Program flexibility that offers additional incentives during high or low commodity prices may reduce grassland conversion to crops for enrollees during such times.

This study has several limitations. The first is the exploratory design of my survey. I did not ask about the extent of participation in a FBCP namely, type of FBCP, time of participation, or amount of land enrolled. Additionally, enrollment in a FBCP was significantly different for the three states and this study specifically targeted agriculture producers. The information contained in this paper can only be used to understand general relationships between dichotomous enrollment and my other study variables. Another limitation of this study is geographic. Grasslands throughout the U.S. are imperiled and increased conversion rates threaten them all (Lark et al., 2015). While these limitations do not detract from the utility of my findings or their implications, by acknowledging them I hope to facilitate future research based on this study.

To maximize the efficacy of FBCPs in conserving grasslands in the PPPE, it is important to understand what motivates people to enroll or not, who are the enrollees, and how enrollment affects grassland conservation. This study provides conservation professionals and policy makers with information to inform program policy, messaging, and recruitment efforts to increase enrollment in FBCPs in grassland ecosystems. Further

research on the relationship between enrollment in a FBCP, receipt of Farm Bill agriculture program payments and having and maintaining land in grass, is needed to re-evaluate the policy. This study also suggests the need for additional methods to conserve the PPPE, for example, nonprofit grassroots efforts.

17. Acknowledgments

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CHAPTER 5: CONCLUSIONS

The Plains and Prairie Potholes Ecoregion (PPPE) contains grassland and wetland ecosystems, which are important for producing agricultural commodities and providing ecosystems services (PPPLCC n.d., Sala and Paruelo 1997). Over 80% of the land in the PPPE is privately owned and almost 75% is used for agriculture (Natural Resources Council of Maine 2000, U.S. Census Bureau 2012, U.S. Department of Agriculture and National Agricultural Statistics Service 2013, Vincent et al. 2014). Recent increase in demand for corn and soybean commodities, improvements in technology, and favorable agricultural policies have resulted in expansions of row crop agriculture operations (Claassen et al. 2011, Lark et al. 2015). While grassland ecosystems are in danger throughout the world, the PPPE is one of the planet's most imperiled ecoregions with half of all grasslands converted in the U.S. from 1997 to 2007 located in the PPPE and rates of expansion in the area increased by 1-5% from 2006 to 2011 (Hoekstra et al. 2005, Stephens et al. 2008, Claassen et al. 2011, Wright and Wimberly 2013).

Conservation professionals are extremely concerned that the loss of grasslands and wetlands will jeopardize the integrity of the PPPE ecosystems and are looking for new solutions to improve their conservation initiatives (U.S. Government Accountability Office 2007). Current conservation efforts in the PPPE primarily rely on voluntary participation in incentive-based government conservation programs for private landowners (Claassen 2014, Reimer 2015). This research aimed to assist conservation professionals' efforts by improving the understanding of

the PPPE's private landowners' demographics, attitudes, values, motivations, behaviors, and operations.

First, I developed the Land Use Value (LUV) scale, a tool to measure conservation related land use values of farmers and ranchers in the PPPE (Chapter 1). I used a multi-step process to develop and evaluate items for the LUV scale, which resulted in a 13-item scale, with Human and Nature-centered dimensions, and identified four LUV types: Humans First, Nature First, Interconnected, and Disconnected. Using the South Dakota sample, the LUV scale proved to have excellent validity and reliability in explaining conservation related attitudes, values, motivations, and behaviors of agricultural producers.

Second, I used the LUV scale to understand and predict conservation behaviors of private landowners from Minnesota, North Dakota, and South Dakota and recommended conservation policies, programs, and messaging in accordance with each LUV type, in order to maximize conservation outcomes (Chapter 2). Humans First LUV types focused on crop production and finances and were not interested in the environment or wildlife. Nature First LUV types also emphasized crop production but focused on the environment and wildlife more than the other types. Interconnected focused on both agricultural commodity production, including livestock, and the environment and wildlife and Disconnected were most motivated by crop production but the amount of importance they gave to all aspects of agriculture was lower than the other LUV types.

Third, I evaluated the use of Farm Bill Conservation Programs, the primary tools used by the U.S. federal and state governments to encourage conservation practices by private landowners, to conserve grassland and wetland habitat in the PPPE. While program participants had positive environmental attitudes, values, and behaviors, they also had less land in grass and were more likely to convert planted grasslands to row crop and remove wetlands than nonparticipants. While these results were surprising, they supported findings in other research (U.S. Government Accountability Office 2007, Claassen et al. 2011, Feng et al. 2013, Miao et al. 2016, Wang et al. 2017, Wimberly et al. 2017).

Another important finding that bears repeating was that all landowners in my sample were universally motivated by production and uniformly concerned with finances. Conservation professionals have attacked agriculture producers for solely being focused on money (Wuerthner and Matteson 2002). This type of response to agricultural producers' financial concerns only serves to alienate them from the conservation domain. If collaborative conservation efforts are to succeed, it will be extremely important for conservation professionals to remember and acknowledge that the nature of agriculture is to use land to produce economic goods.

The PPPE is an imperiled ecoregion, which is important to people and animals. Current conservation initiatives are ineffective and insufficient for maintaining the integrity of the PPPE. The research presented in this dissertation provides a starting point for decision-makers to re-evaluate current agriculture and environmental conservation policies, programs, and messaging. This research provides a tool for conservation professionals to evaluate and align their conservation efforts with the land use values of private landowners in the PPPE. Conservation

professionals can also use the LUV scale to help identify suitable candidates for conservation initiatives. Conservation decision-makers should also use this information to explore alternative conservation initiatives, such as market-based incentive programs, which pay for conservation results instead of practices and behaviors (Stern 2006, Pascual and Perrings 2007, Burton et al. 2008, Hartig and Drechsler 2009). I hope this dissertation will help conservation practitioners recognize the peril of current practices in the PPPE and make necessary changes. The future of the PPPE depends on our ability do so.

APPENDIX

1. Cover Letter and Questionnaire for Minnesota

Minnesota Private Landowner Opinions about Land Use & Wildlife

<SurveyID>
<Name>
<Address>
<City, State, Zip>

Greetings,

We are writing to ask for your help with a survey of private landowners in Minnesota. We know that Minnesota landowners have a rich history of land stewardship but until recently that has largely gone undocumented. The purpose of this survey is to learn what it is like to be a landowner in Minnesota and to document your opinions about land use and wildlife.

This survey aims to improve our understanding of three main aspects of landowners in Minnesota: who you are, what you do, and how your relationships with the land and wildlife affect your decisions. State agency staff will use this information to evaluate private landowner conservation programs. We expect the results of this survey to reveal a connection between agriculture and conservation.

This survey is part of a multi-state effort with South Dakota State University, the Minnesota Department of Natural Resources (MNDNR), and wildlife agencies in other states. A similar survey will also be mailed to landowners in Iowa, North Dakota, South Dakota, and Montana.

We estimate this questionnaire will take less than 30 minutes to complete. Your participation is voluntary (returning a blank survey will let us know that you do not wish to participate.) Each questionnaire has an identification number to prevent duplicate mailings to those who have already responded. In order to protect your anonymity, please do NOT provide your name or address on the questionnaire. Your responses will be confidential, only summarized information will be included in the final report.

The final report will be made available to the public in fall, 2017, through the MNDNR website and/or by writing to the address below. Thank you in advance for helping us with this important research and we look forward to receiving your completed questionnaire! If you have any questions, please contact me at the email below.

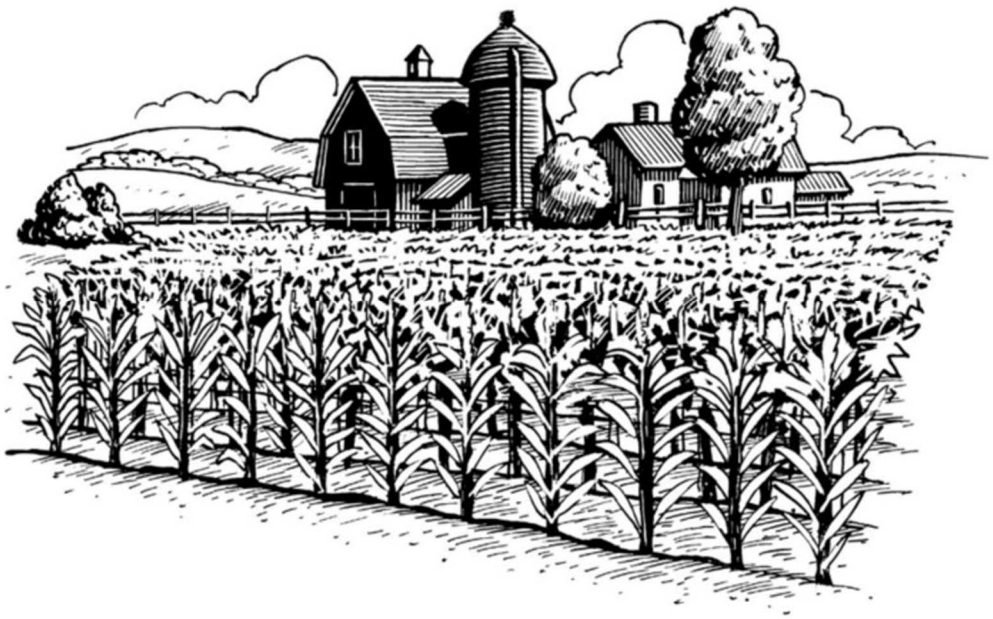
Sincerely,

Lou Cornicelli

Minnesota Department of Natural Resources
500 Lafayette Rd., St. Paul, MN 55155
lou.cornicelli@state.mn.us

Minnesota Landowner Survey

Farming, Ranching, & Wildlife Habitat (2016)



Minnesota Department of Natural Resources
500 Lafayette Rd.
St. Paul, MN 55155

1. **Your Opinion** *Please circle one number for each statement.*	Disagree		Neither	Agree	
	Strong	Slight		Slight	Strong
a) It is important for state and federal government agencies to understand Minnesota landowners.	1	2	3	4	5
b) Scientific surveys are a good way to collect information about landowners.	1	2	3	4	5

2. *Please check all that apply*. Do you consider yourself a …

❑ Farmer ❑ Rancher ❑ Neither → *if Neither, skip ahead to question #8*

➔ If farmer and/or rancher, are you currently: ❑ Full-time ❑ Part-time ❑ Retired

3. How much land do you currently own and operate/lease?

Please check [√] one box

❑ a) Less than 80 acres	❑ e) 641 – 1,280 acres
❑ b) 81 –160 acres	❑ f) 1,281 – 3,840 acres
❑ c) 161 – 320 acres	❑ g) More than 3,840 acres
❑ d) 321 – 640 acres	

4. About what percent of your total household income is derived from farming/ranching?

❑None ❑1 – 25% ❑26 – 50% ❑51 – 75% ❑76 – 100%

5. How long have you, or did you, farm/ranch? *Please check [√] one box.*

0 – 5 years	6 – 10 years	11-20 years	21-30 years	More than 30 years
❑	❑	❑	❑	❑

6. On the acres (owned & leased) about what percent was used for each of these categories last year?

Planted commodities (such as corn, soybeans, wheat, oats)	_____ %
Pasture, hay	_____ %
Native Grassland or Prairie	_____ %
Set-aside conservation program (such as CRP, WRP, CREP)	_____ %
Remaining lands (such as homestead, trees, bushes, wetlands)	_____ %
TOTAL	**100%**

7. On the land you own/operate, what % do you currently make land-use decisions about (such as, commodity/livestock production, types of crops planted, participation in conservation programs)?

❑None ❑1 – 25% ❑26 – 50% ❑51 – 75% ❑76 – 100%

Farm/Ranch Land Use Practices

8. Below are statements representing different types of farming and ranching practices. We'd like to know whether you are currently employing these practices, if you have in the past, or if you plan to in the future, on the land you own/operate. *Please check all that apply for each row.*

Practices	Done in the past? No	Done in the past? Yes	Maintain/ currently do now	Plan to do in the future	Does not apply
a) Conduct soil tests		❑	❑	❑	❑
b) Use conservation tillage practices	❑	❑	❑	❑	❑
c) Rotate crops	❑	❑	❑	❑	❑
d) Plant cover crops	❑	❑	❑	❑	❑
e) Plant trees and shrubs (e.g. shelter belts)	❑	❑	❑	❑	❑
f) Control agricultural run-off	❑	❑	❑	❑	❑
g) Plant and maintain filter strips	❑	❑	❑	❑	❑
h) Establish or restore wetlands	❑	❑	❑	❑	❑
i) Use herbicides	❑	❑	❑	❑	❑
j) Use integrated pest management	❑	❑	❑	❑	❑
k) Use insecticide	❑	❑	❑	❑	❑
l) Use a written grazing management plan	❑	❑	❑	❑	❑
m) Provide livestock with water tanks	❑	❑	❑	❑	❑
n) Plant pollinator seed mixes	❑	❑	❑	❑	❑
o) Protect milkweed to feed monarch larvae	❑	❑	❑	❑	❑
p) Manage/maintain wetlands for wildlife	❑	❑	❑	❑	❑
q) Plant food plots	❑	❑	❑	❑	❑
r) Manage grasslands for wildlife	❑	❑	❑	❑	❑
s) Use non-lethal methods (e.g. hazing, fencing) to prevent/reduce property damage	❑	❑	❑	❑	❑
t) Use lethal methods (e.g. shooting, trapping) to prevent/reduce property damage	❑	❑	❑	❑	❑
u) Allow free public hunting access with permission	❑	❑	❑	❑	❑
v) Provide hunting access for a fee (lease your property)	❑	❑	❑	❑	❑

9. On the land you own/operate, in the past 10 years (2005 – 2015), did you convert any pasture, hayfields, or other grasslands to crops? *Please check [√] one box.* ❑ No ❑ Yes

   ➔ *If Yes, please check [√] all types of pasture or grassland converted:*
   ❑ Virgin/ Native pasture or grassland ❑ Planted grassland (including CRP)

10. On the land you own/operate, in the past 10 years (2005 – 2015), did you drain or minimize any wet areas on your land? *Please check [√] one box.* ❑ No ❑ Yes

11. Please rate the importance of each of the following reasons for why you might use one or more of the land use practices on the previous page. *Please circle <u>one</u> number for each row.*

Reasons	Not Important	Slightly Important	Moderately Important	Very Important
a) Provide shelter for wildlife	1	2	3	4
b) Financial considerations	1	2	3	4
c) Control wildlife	1	2	3	4
d) Raise and produce livestock	1	2	3	4
e) Produce and grow agricultural crops	1	2	3	4
f) Remove/control unwanted plants	1	2	3	4
g) Prevent soil erosion	1	2	3	4
h) Increase grazing season length	1	2	3	4
i) Improve productivity	1	2	3	4
j) Provide habitat for wildlife	1	2	3	4
k) Protect fisheries	1	2	3	4
l) Produce and grow feedstock	1	2	3	4
m) Protect riparian vegetation	1	2	3	4
n) Provide water for wildlife	1	2	3	4
o) Control insects	1	2	3	4
p) Provide food for wildlife	1	2	3	4
q) Increase plant diversity	1	2	3	4
r) Protect water quality	1	2	3	4
s) Attract and feed bees & butterflies	1	2	3	4
t) Encourage quick vegetation recovery	1	2	3	4

12. Please rate how important each of these wildlife categories are to decisions you make about land use. *Please circle <u>one</u> number for each row.*

Wildlife categories	Not Important	Slightly Important	Moderately Important	Very Important
a) Deer	1	2	3	4
b) Game birds like pheasants and grouse	1	2	3	4
c) Wetland species like ducks and geese	1	2	3	4
d) Coyotes, foxes, other small predators	1	2	3	4
e) Other non-game mammals like skunks	1	2	3	4
f) Hawks, eagles, owls, and other birds of prey	1	2	3	4
g) Songbirds and shorebirds	1	2	3	4
h) Fish, reptiles, & amphibians	1	2	3	4
i) Bees and other pollinators	1	2	3	4
j) Monarchs and other butterflies	1	2	3	4
k) Other insects	1	2	3	4

13. We would like to know about the land you own/operate that you consider to be marginal for farming. *Circle <u>one</u> response for each statement.* Examples of marginal land are land that doesn't make a profit or has poor soil.

Some of my land is marginal for farming because….	**Strongly Disagree**	**Moderately Disagree**	**Slightly Disagree**	**Neutral**	**Slightly Agree**	**Moderately Agree**	**Strongly Agree**	**If you agree →**	**How many acres are "very marginal" for this reason?**
a) It has poor soil	1	2	3	4	5	6	7	→	_____ac
b) It is too wet	1	2	3	4	5	6	7	→	_____ac
c) It is too steep	1	2	3	4	5	6	7	→	_____ac
d) Other: _____	1	2	3	4	5	6	7	→	_____ac

14. We are very interested in knowing what your farm means to you. Please indicate the extent to which you agree or disagree with the following statements. *Circle <u>one</u> response for each statement.*

Statement	**Strongly Disagree**	**Moderately Disagree**	**Slightly Disagree**	**Neutral**	**Slightly Agree**	**Moderately Agree**	**Strongly Agree**
a) My farm represents my family history.	1	2	3	4	5	6	7
b) I'm proud of my family history on the farm.	1	2	3	4	5	6	7
c) My farm is an important part of my personal history.	1	2	3	4	5	6	7
d) Farming says a lot about who I am.	1	2	3	4	5	6	7
e) Farming helps define who I am.	1	2	3	4	5	6	7
f) My farm is primarily a business.	1	2	3	4	5	6	7
g) It is important to pass my farm on to future generations	1	2	3	4	5	6	7
h) My farm is a way for me to financially provide for my family.	1	2	3	4	5	6	7
i) My farm is an important source of income.	1	2	3	4	5	6	7

15. We are interested in knowing your perceptions of change in the natural conditions on and around your land, over the past 30 years. *For each condition below please circle <u>one</u> response.*

Natural Condition	Decreased	No Change	Increased	No Opinion
a) Soil quality	1	2	3	4
b) Water quality	1	2	3	4
c) Vegetation/forage quality	1	2	3	4
d) Farm/ranch productivity	1	2	3	4
e) Wildlife habitat quality	1	2	3	4
f) Presence of wildlife/game	1	2	3	4

USDA Farm Bill Conservation Programs

The Farm Bill is a compilation of several pieces of federal legislation, which governs agriculture and conservation programs intended to enhance agricultural productivity and conservation on private lands. We are interested in learning about any experience you may have had with the USDA Conservation Programs contained within the Farm Bill.

16. Have you enrolled any of your land in a USDA Farm Bill Conservation Program (such as, CRP, WRP, EQIP, CREP) in the past 30 years?
    Please check [√] one box. ❑ No ❑ Yes

17. Please indicate the importance of each of the following reasons to your participation in a Farm Bill Conservation Program. *Please circle one number for each statement.*

Reasons for participating in a Farm Bill Conservation Program	Not a Reason	Slightly Important	Moderately Important	Very Important
a) Improve soil quality	1	2	3	4
b) Improve habitat for game species	1	2	3	4
c) Protect endangered species	1	2	3	4
d) Tax credits/benefits	1	2	3	4
e) Provide habitat for monarch butterflies	1	2	3	4
f) Financial compensation	1	2	3	4
g) Improve habitat for non-game wildlife	1	2	3	4
h) Improve water quality	1	2	3	4
i) Support native grass plantings	1	2	3	4
j) Provide habitat for pollinators	1	2	3	4
k) Provide habitat buffers for upland birds	1	2	3	4
l) Provide shallow water (wet) areas	1	2	3	4
m) Provide river/stream buffer strips	1	2	3	4
n) Increase plant diversity	1	2	3	4

18. Please indicate the importance of each of the following reasons for why **you have *not* participated** or **no longer participate** in a Farm Bill Conservation Program. *Please circle one number for each row.*

Reasons for *Not* participating in a Farm Bill Conservation Program	Not a Reason	Slightly Important	Moderately Important	Very Important
a) Do not want to sign a contract with the government	1	2	3	4
b) Decreases my options for using my property	1	2	3	4
c) Increases my expenses	1	2	3	4
d) Takes a lot of time and effort	1	2	3	4
e) The financial incentives are not high enough	1	2	3	4
f) I don't have any land that qualifies	1	2	3	4
g) The programs are too complicated and confusing	1	2	3	4
h) The length of the agreement (in years) is too long	1	2	3	4
i) There are not enough enrollment opportunities	1	2	3	4
j) Do not want to work with a conservation partner (e.g Ducks Unlimited) to enroll my land	1	2	3	4

Future Plans

According to the USDA's 2012 Census of Agriculture, 68% of farmers are over the age of 55, and less than 1% are under the age of 25. These facts raise concerns about the future of farming and ranching lifestyles and legacies. We'd like to ask about your plans for your land to see if conservation programs could help protect farming and ranching livelihoods and legacies.

19. Are you planning on changing the size of your operation in the next 10 years?
Please check [√] one box.

Decrease	No Change	Increase	No Opinion
❑	❑	❑	❑

20. What do you think is the possibility of the following options for the land you own/operate when you retire or are no longer able to run the farm/ranch? *Please circle one response for each statement.*

Future Options for you Land	None	Slight	Moderate	Strong	Does not Apply
a) Sell all of the land, at one time, to a willing buyer	1	2	3	4	5
b) Sell off parts of the land and reduce the amount of the land owned	1	2	3	4	5
c) Let my family inherit the land and develop their own operation methods	1	2	3	4	5
d) Pass the land and methods of operation to my family	1	2	3	4	5
e) Sell all of the land to a person or organization that will continue the same operations	1	2	3	4	5
f) Sell/donate the land to an organization that will protect the land from development	1	2	3	4	5
g) Enroll the land in a conservation program that prevents development	1	2	3	4	5

Land Use Relations

21. Below are 15 statements representing different ways people think about land use. The purpose of this section is to learn how **you** relate to the land and to help us understand your land use practice choices (Questions 8-10). This is not a test, there are no correct or wrong answers. *Please circle one response for each statement.*

Statement	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
a) The diversity of plants and wildlife in an area is a sign of the quality of the natural environment.	1	2	3	4	5	6	7
b) Because farmers' and ranchers' livelihoods depend on the land, they are the best stewards of the land.	1	2	3	4	5	6	7
c) Farmers and ranchers have an obligation to protect the soil, water, plants, habitat, and fish and wildlife on their land.	1	2	3	4	5	6	7
d) The best use of land should be determined by the amount of profit that can be earned annually.	1	2	3	4	5	6	7

(Continued)

21. *Land Use Relations Continued*

Statement	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
e) Large-scale restoration, across the landscape, is required to improve the condition of the land.	1	2	3	4	5	6	7
f) Farmers/ranchers should focus on optimizing production on their farm/ranch regardless of environmental costs.	1	2	3	4	5	6	7
g) Farmers and ranchers have the right to use the soil, water, plants, and animals on their land in any way they see fit.	1	2	3	4	5	6	7
h) All parts of the ecosystem, down to the microorganisms in the soil, are important for proper functioning of the landscape.	1	2	3	4	5	6	7
i) If you take care of the land, it will take care of you.	1	2	3	4	5	6	7
j) Restored lands maximize both productivity and ecosystem function.	1	2	3	4	5	6	7
k) The quality of the land is positively influenced by the diversity of native plants and animals that live on or around it.	1	2	3	4	5	6	7
l) The needs of farmers and ranchers should take priority over the conservation of land.	1	2	3	4	5	6	7
m) Farmers and ranchers are masters of the land.	1	2	3	4	5	6	7
n) We should restore the landscape to the way it was when the pioneers first arrived.	1	2	3	4	5	6	7
o) Farmers and ranchers are only temporary trustees of the land and it is their responsibility to take good care of it for future generations.	1	2	3	4	5	6	7

Environmental Protection and Quality

22. We would like to understand what level of responsibility you feel you have to protect environmental resources when you farm. *(For each statement below, circle one response).*

Statement	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
a) I have a responsibility to implement farming practices that protect water quality.	1	2	3	4	5	6	7
b) I have a responsibility to implement farming practices that protect wildlife habitat.	1	2	3	4	5	6	7
c) I have a responsibility to minimize the level of nitrates and other farm chemicals I use.	1	2	3	4	5	6	7

(Continued)

22. *Level of responsibility continued*

Statement	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
d) I feel a strong obligation to protect the local environment where I farm.	1	2	3	4	5	6	7
e) Protecting the environment is not my responsibility.	1	2	3	4	5	6	7

23. Listed below are several potential ways that farming could affect environmental quality. For your farm operations, please tell us if you think the way you farm has a NEGATIVE or POSITIVE effect on each. (*Circle one number that best corresponds to your answer*).

I think that the way I farm has a Negative or Positive Effect on…	Extremely Negative	Quite Negative	Slightly Negative	Neutral	Slightly Positive	Quite Positive	Extremely Positive
a) Water quality around my farm	1	2	3	4	5	6	7
b) Long-term productivity of my farm	1	2	3	4	5	6	7
c) Wildlife habitat	1	2	3	4	5	6	7
d) Soil erosion on my farm	1	2	3	4	5	6	7
e) The amount of farm income I receive	1	2	3	4	5	6	7
f) General environmental quality	1	2	3	4	5	6	7
g) The amount of nitrates and other farm chemicals in the surface and ground water in my area	1	2	3	4	5	6	7

24. Please let us know how you feel about the Minnesota Department of Natural Resources. (*Please circle one response for each of the following statements.)*

Statement	Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
a) The MnDNR does a good job of managing wildlife in Minnesota.	1	2	3	4	5
b) When deciding about wildlife management in Minnesota, the MnDNR will be open and honest in the things they do and say.	1	2	3	4	5
c) The MnDNR can be trusted to make decisions about wildlife management that are good for the resource.	1	2	3	4	5
d) The MnDNR will make decisions about wildlife management in a way that is fair.	1	2	3	4	5
e) The MnDNR has wildlife managers and biologists who are well-trained for their jobs.	1	2	3	4	5
f) The MnDNR listens to the concerns of landowners.	1	2	3	4	5

Fish and Wildlife Values

25. Below are 13 statements representing different ways people value wildlife. The purpose of this section is to learn how **you** relate to wild animals. This information will help us understand your practice choices (Questions 8-10). This is not a test, there are no right or wrong answers. *Please circle* one *response for each statement.*

Statement	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
a) Humans should manage fish and wildlife populations so that humans benefit.	1	2	3	4	5	6	7
b) Animals should have rights similar to the rights of humans.	1	2	3	4	5	6	7
c) I view all living things as part of one big family.	1	2	3	4	5	6	7
d) Hunting does not respect the lives of animals.	1	2	3	4	5	6	7
e) I feel a strong emotional bond with animals.	1	2	3	4	5	6	7
f) The needs of humans should take priority over fish and wildlife protection	1	2	3	4	5	6	7
g) I care about animals as much as I do other people.	1	2	3	4	5	6	7
h) Fish and wildlife are on earth primarily for people to use.	1	2	3	4	5	6	7
i) Hunting is cruel and inhumane to the animals.	1	2	3	4	5	6	7
j) We should strive for a world where humans and fish and wildlife can live side by side without fear.	1	2	3	4	5	6	7
k) I value the sense of companionship I receive from animals.	1	2	3	4	5	6	7
l) Wildlife are like my family and I want to protect them.	1	2	3	4	5	6	7
m) People who want to hunt should be provided the opportunity to do so.	1	2	3	4	5	6	7

Some Information about Yourself

26. What is your age? _____ years

27. What is your gender? ❑ Male ❑ Female

28. In which county do you live? _____

29. Do you consider yourself a hunter? ❑ No ❑ Yes

➔ If Yes…How important is hunting compared to all your other recreation activities? *Please check [√] one box.*

Not Important	Slightly Important	Moderately Important	Very Important	Most Important
❑	❑	❑	❑	❑

➔ If Yes… Last year (2015), about how many days did you hunt, fish, and trap?

_____ Days hunting on land you own or lease

_____ Days hunting not on land you own or lease

If you have any comments, please use the space below.

_____

_____

_____

_____

_____

_____

Thank you very much for your participation!

2. Cover Letter and Questionnaire for North Dakota

0001

SOUTH DAKOTA STATE UNIVERSITY

PLAINS & PRAIRIE POTHOLES
LANDSCAPE CONSERVATION COOPERATIVE

January 4, 2016

RE: North Dakota Private Landowner Opinions about Land Use and Wildlife

Dear North Dakota Landowner,

I am writing to ask for your help with a survey of private landowners in North Dakota. I know that North Dakota landowners have a rich history of land stewardship but until now that has largely gone undocumented. The purpose of this survey is to learn what it is like to be a landowner in North Dakota and to document your opinions about land use and wildlife.

This survey aims to improve the understanding of three main aspects of landowners in North Dakota: who you are, what you do, and how your relationships with the land and wildlife affect your decisions. State agency officials will be able to use this information to evaluate and improve private land conservation programs. I expect the results of this survey to reveal a strong connection between agriculture and conservation.

This survey is part of a larger research study focused on land use in the Northern Plains and Prairie Pothole region of Iowa, Minnesota, South Dakota, North Dakota, and Montana. Researchers at the University of North Dakota and natural resources managers at the North Dakota Game and Fish Department assisted with the development of the survey, while staff at the North Dakota Department of Agriculture provided helpful comments while reviewing the document. Surveys are being sent to randomly selected landowners in each of these states. I will summarize the data to look for trends within each state and across the region, and write the final reports.

The final report will be made available to the public no later than September 30th, 2017, through the PPP-LCC website (http://www.plainsandprairiepotholeslcc.org/) and will also be available through a wide number of outlets via the many researchers and natural resource managers involved with this project. If you have any questions or concerns about this survey you can contact me by email or by writing to me at the address on the bottom of this letter. Thank you in advance for helping me with this important research and I look forward to receiving your completed survey!

Sincerely,

Lily Sweikert

Lily Sweikert, Project Coordinator
Doctoral Student
Email: sdsu.nrm.humandimensions@sdstate.edu

South Dakota State University
Department of Natural Resource Management

Box 2014B
Brookings, SD 57007

NORTH DAKOTA LANDOWNER SURVEY

FARMING, RANCHING AND WILDLIFE HABITAT (2016)

SOUTH DAKOTA STATE UNIVERSITY
Department of Natural Resource Management
Box 2014B
Brookings, SD 57007

SURVEY INSTRUCTIONS

I estimate this survey will take about 30 minutes to complete. Your participation is voluntary (returning a blank survey will let me know that you do not wish to participate.) Each questionnaire has an identification number to prevent duplicate mailings to those who have already responded. In order to protect your anonymity, please do NOT provide your name or address on the survey. Your responses will be confidential, only summarized information will be included in the final report.

1. Please check ***all*** that apply. Do you consider yourself a ...

   ☐ Farmer ☐ Rancher ☐ Neither ***(if neither, skip ahead to Question #3)***

   If farmer and/or rancher, are you currently ***(Please check one box):***

   ☐ Full-time ☐ Part-time ☐ Retired

2. How long have you or did you farm/ranch? ***(Please check one box):***

   ☐ 0 – 5 years ☐ 6 – 10 years ☐ 11 – 20 years ☐ 21 – 30 years ☐ More than 30 years

3. How much land do you currently own and operate/lease? ***(Please check one box):***

   ☐ a. Less than 80 acres
   ☐ b. 81 –160 acres
   ☐ c. 161 – 320 acres
   ☐ d. 321 – 640 acres
   ☐ e. 641 – 1,280 acres
   ☐ f. 1,281 – 3,840 acres
   ☐ g. More than 3,840 acres

4. On the land you own/operate, what percent do you currently make land-use decisions about (e.g., commodity/livestock production/participation in conservation programs)?

   ☐ None ☐ 1 – 25% ☐ 26 – 50% ☐ 51 – 75% ☐ 76 – 100%

5. On the land you own/operate, about what percentage were used for each of these categories last year (2015)?

Planted commodities (e.g., corn, soybeans, wheat, oats, etc.)	_____%
Native grassland, pasture, and hay	_____%
Lands enrolled in a conservation program (e.g., CRP, WRP, etc.)	_____%
Remaining lands (e.g., tress, bushes, wetlands, etc.)	_____%
TOTAL	**100%**

FARM/RANCH LAND USE PRACTICES

6. Below are statements representing different types of farming and ranching practices. We'd like to know whether you are currently employing these practices, if you have in the past, or if you plan to in the future, on the land you own/operate. ***Please check all that apply for each row.***

PRACTICES	DONE IN THE PAST? NO	DONE IN THE PAST? YES	MAINTAIN/ CURRENTLY DO NOW	PLAN TO DO IN THE FUTURE	DOES NOT APPLY
a) Conduct soil testing	☐	☐	☐	☐	☐
b) Use conservation tillage practices	☐	☐	☐	☐	☐

(continued)

	Practices	Done in the Past? No	Done in the Past? Yes	Maintain/ Currently do now	Plan to do in the Future	Does not Apply
c)	Rotate crops	☐	☐	☐	☐	☐
d)	Plant cover crops	☐	☐	☐	☐	☐
e)	Plant trees and shrubs (e.g., shelter belts)	☐	☐	☐	☐	☐
f)	Control agricultural run-off	☐	☐	☐	☐	☐
g)	Plant and maintain filter strips	☐	☐	☐	☐	☐
h)	Establish or restore wetlands	☐	☐	☐	☐	☐
i)	Use herbicides	☐	☐	☐	☐	☐
j)	Use integrated pest management	☐	☐	☐	☐	☐
k)	Use insecticides	☐	☐	☐	☐	☐
l)	Use a written grazing management plan	☐	☐	☐	☐	☐
m)	Provide livestock with water tanks	☐	☐	☐	☐	☐
n)	Plant pollinator seed mixes	☐	☐	☐	☐	☐
o)	Protect milkweed to feed monarch larvae	☐	☐	☐	☐	☐
p)	Manage/maintain wetlands for wildlife	☐	☐	☐	☐	☐
q)	Plant food plots	☐	☐	☐	☐	☐
r)	Manage grasslands for wildlife	☐	☐	☐	☐	☐
s)	Use non-lethal methods (e.g., hazing, fencing) to prevent/reduce property damage from wildlife	☐	☐	☐	☐	☐
t)	Use lethal methods (e.g., shooting, trapping) to prevent/reduce property damage from wildlife	☐	☐	☐	☐	☐
u)	Allow free reasonable public hunting access	☐	☐	☐	☐	☐
v)	Provide hunting access for a fee	☐	☐	☐	☐	☐

7. Please rate the importance of each of the objectives/reasons for why you might use one or more of the various land use practices above. (***Please circle <u>one</u> number for each row.***)

	Reasons	Not a Reason	Slightly Important	Moderately Important	Very Important
a)	Provide shelter for wildlife	1	2	3	4
b)	Financial considerations	1	2	3	4
c)	Control wildlife	1	2	3	4
d)	Raise and produce livestock	1	2	3	4
e)	Produce and grow agricultural crops	1	2	3	4
f)	Remove/control unwanted plants	1	2	3	4
g)	Prevent soil erosion	1	2	3	4
h)	Increase grazing season length	1	2	3	4
i)	Improve productivity	1	2	3	4
j)	Provide habitat for wildlife	1	2	3	4
k)	Protect fisheries	1	2	3	4
l)	Produce and grow feedstock	1	2	3	4
m)	Protect riparian vegetation	1	2	3	4
n)	Provide water for wildlife	1	2	3	4
o)	Control insects	1	2	3	4
p)	Provide food for wildlife	1	2	3	4
q)	Increase plant diversity	1	2	3	4
r)	Protect water quality	1	2	3	4
s)	Attract and feed bees and butterflies	1	2	3	4
t)	Encourage quick vegetation recovery	1	2	3	4

8. Please rate how important each of these wildlife categories are to decisions you make about land use. ***(Please circle <u>one</u> number for each row.)***

	Wildlife Categories	Not a Reason	Slightly Important	Moderately Important	Very Important
a)	Deer, elk, pronghorn, etc.	1	2	3	4
b)	Pheasant, grouse, etc.	1	2	3	4
c)	Ducks and geese	1	2	3	4
d)	Coyotes, fox, mountain lions, etc.	1	2	3	4
e)	Other nongame mammals	1	2	3	4
f)	Hawks, eagles, owls, etc.	1	2	3	4
g)	Songbirds and shorebirds	1	2	3	4
h)	Fish	1	2	3	4
i)	Reptiles and amphibians	1	2	3	4
j)	Bees	1	2	3	4
k)	Monarchs and other butterflies	1	2	3	4
l)	Other insects	1	2	3	4

9. On the land you own/operate, in the past 10 years (2005 – 2015), did you convert any pasture or other grasslands to crops? ***(Please check <u>one</u> box.)***

   ☐ No ☐ Yes

   If yes, please check ***<u>all</u>*** types of pasture or grassland converted:

   ☐ Virgin/Native Pasture or Grassland ☐ Planted Grassland (e.g., CRP)

10. On the land you own/operate, in the past 10 years (2005 – 2015), did you drain, move, or minimize any wet areas on your land? ***(Please check <u>one</u> box.)***

    ☐ No ☐ Yes

11. We're interested in knowing your perceptions of change in the natural conditions on and around your land over the past <u>30 years</u>. ***(Please circle <u>one</u> number for each condition below.)***

	Natural Condition	Decreased	No Change	Increased	No Opinion
a)	Soil quality	1	2	3	4
b)	Water quality	1	2	3	4
c)	Vegetation/forage quality	1	2	3	4
d)	Farm/ranch productivity	1	2	3	4
e)	Wildlife habitat quality	1	2	3	4
f)	Presence of wildlife/game	1	2	3	4

USDA Farm Bill Conservation Programs

The Farm Bill is a compilation of several pieces of federal legislation, which governs agriculture and conservation programs intended to enhance agricultural productivity and conservation on private lands. We are interested in learning about any experience you may have had with the USDA Conservation Programs contained within the Farm Bill.

12. In the past 10 years (2005 – 2015), did you enroll any of the land you own/operate in a Farm Bill Conservation Program? ***(Please check <u>one</u> box.)***

    ☐ No ☐ Yes

    If yes, which programs? (Please check <u>all</u> that apply or leave blank if unsure.)

    ☐ a) Conservation Reserve Program (CRP)

    ☐ b) Grassland Reserve Program (GRP) (Now ALE – Ag Land Easement Program)

    ☐ c) Wetland Reserve Program (WRP) (Now WRE – Wetland Reserve Easement)

    ☐ d) Conservation Reserve Enhancement Program (CREP)

    ☐ e) Conservation Security Program (CSP)

    ☐ f) Environmental Quality Incentives Program (EQIP)

    ☐ g) Other_____

13. Please indicate the importance of each of the following reasons for your participation in a Farm Bill Conservation Program. ***(Please circle <u>one</u> number for each statement.)***

	Reasons for participating in a Farm Bill Conservation Program	Not a Reason	Slightly Important	Moderately Important	Very Important
a)	Improve soil quality	1	2	3	4
b)	Improve habitat for game species	1	2	3	4
c)	Protect endangered species	1	2	3	4
d)	Tax credits/benefits	1	2	3	4
e)	Provide habitat for monarch butterflies	1	2	3	4
f)	Financial compensation	1	2	3	4
g)	Improve habitat for nongame wildlife	1	2	3	4
h)	Improve water quality	1	2	3	4
i)	Support native grass plantings	1	2	3	4
j)	Provide habitat for pollinators	1	2	3	4
k)	Provide habitat buffers for upland birds	1	2	3	4
l)	Provide shallow water (wet) areas	1	2	3	4
m)	Provide river/stream buffer strips	1	2	3	4
n)	Increase plant diversity	1	2	3	4

14. Please indicate the importance of each of the following reasons for why ***<u>you have not participated</u>*** or ***<u>no longer participate</u>*** in a Farm Bill Conservation Program. ***(Please circle <u>one</u> number for each row.)***

	Reasons for <u>Not</u> participating in a Farm Bill Conservation Program	Not a Reason	Slightly Important	Moderately Important	Very Important
a)	Do not want to sign a contract with the government	1	2	3	4
b)	Decreases my options for using my property	1	2	3	4
c)	Increases my expenses	1	2	3	4
d)	Do not want to work with a conservation partner to enroll my land	1	2	3	4
e)	Takes a lot of time and effort	1	2	3	4
f)	The financial incentives are not high enough	1	2	3	4
g)	I don't have any land that qualifies	1	2	3	4
h)	The programs are too complicated and confusing	1	2	3	4
j)	There are not enough enrollment opportunities	1	2	3	4

STATE CONSERVATION PROGRAMS

Several North Dakota state agencies and nonprofit organizations have developed conservation programs for private landowners to conserve grassland habitat, plant shrubs and trees, restore wetlands, and provide hunting access.

15. In the past 10 years (2005 – 2015), did you enroll any of the land you own/operate in a state conservation program? ***(Please check <u>one</u> box.)***

☐ No ☐ Yes

If Yes, which programs? ***(Please check <u>all</u> that apply or leave blank if unsure.)***

☐ a) Waterbank Program – ND Department of Agriculture

☐ b) Tree, shrub or windbreak planting or enhancement – ND Forest Service

☐ c) Livestock Pollution Prevention (LP3) program – ND Department of Agriculture

☐ d) Private Land Open To Sportsmen (PLOTS) program – ND Game and Fish Department

☐ e) Other programs offered through other agencies or groups _____

FUTURE PLANS

According to the USDA's 2012 Census of Agriculture, 68 percent of farmers are over the age of 55, and only 0.6 percent are under the age of 25. These facts raise concerns about the future of farming and ranching lifestyles and legacies. We'd like to ask you about your plans for your land to see if conservation programs could help protect farming and ranching livelihoods and legacies.

16. Are you planning to change the size of your operation in the next 10 years?

(Please check <u>one</u> box.)

☐ Decrease ☐ No Change ☐ Increase ☐ No Opinion

17. What do you think is the possibility of the following options for the land you own/operate when you retire or are no longer able to run the farm/ranch? (***Please circle <u>one</u> response for each statement.)***

	FUTURE OPTIONS FOR YOUR LAND	POSSIBILITY OF OPTION HAPPENING				DOES NOT APPLY
		NONE	SLIGHT	MODERATE	STRONG	
a)	Sell all of the land, at one time, to a willing buyer	1	2	3	4	5
b)	Sell off parts of the land and reduce the amount of the land owned	1	2	3	4	5
c)	Let my family inherit the land and develop their own operation methods	1	2	3	4	5
d)	Pass the land and methods of operation to my family	1	2	3	4	5
e)	Sell all of the land to a person or organization that will continue the same operations	1	2	3	4	5

(continued)

	Future Options for Your Land	Possibility of Option Happening: None	Slight	Moderate	Strong	Does Not Apply
f)	Sell/donate the land to an organization that will protect the land from development	1	2	3	4	5
g)	Enroll the land in a conservation program that prevents development	1	2	3	4	5

18. Would you be interested in a conservation program that would help your family continue your current farming/ranching operations? ***(Please check <u>one</u> box.)***

☐ No ☐ Yes

Land Use Relations

19. Below are 15 statements representing different ways people think about land use. The purpose of this section is to learn how <u>you</u> relate to the land and to help us understand your land use practice choices (Questions 6 – 8). This is not a test, there are no correct or incorrect answers. ***(Please circle <u>one</u> response for each statement.)***

	Statement	Disagree: Strong	Moderate	Slight	Neither	Agree: Slight	Moderate	Strong
a)	The diversity of plants and wildlife in an area is a sign of the quality of the natural environment.	1	2	3	4	5	6	7
b)	Because farmers' and ranchers' livelihoods depend on the land, they are the best stewards of the land.	1	2	3	4	5	6	7
c)	Farmers and ranchers have an obligation to protect the soil, water, plants, habitat, and fish and wildlife on their land.	1	2	3	4	5	6	7
d)	The best use of land should be determined by the amount of profit that can be earned annually.	1	2	3	4	5	6	7
e)	Large-scale restoration across the landscape is required to improve the condition of the land.	1	2	3	4	5	6	7

(continued)

	Statement	Disagree			Neither	Agree		
		Strong	Moderate	Slight		Slight	Moderate	Strong
f)	Farmers/ranchers should focus on optimizing production on their farm/ranch regardless of environmental costs.	1	2	3	4	5	6	7
g)	Farmers and ranchers have the right to use the soil, water, plants, and animals on their land in any way they see fit.	1	2	3	4	5	6	7
h)	All parts of the ecosystem, down to the microorganisms in the soil, are important for proper functioning of the landscape.	1	2	3	4	5	6	7
i)	If you take care of the land, it will take care of you.	1	2	3	4	5	6	7
j)	Restored lands maximize both productivity and ecosystem function.	1	2	3	4	5	6	7
k)	The quality of the land is positively influenced by the diversity of native plants and animals that live on or around it.	1	2	3	4	5	6	7
l)	The needs of farmers and ranchers should take priority over the conservation of land.	1	2	3	4	5	6	7
m)	Farmers and ranchers are masters of the land.	1	2	3	4	5	6	7
n)	We should restore the landscape to the way it was when the pioneers first arrived.	1	2	3	4	5	6	7
o)	Farmers and ranchers are only temporary trustees of the land and it is their responsibility to take good care of it for future generations.	1	2	3	4	5	6	7

FISH AND WILDLIFE VALUES

20. Below are 13 statements representing different ways people value wildlife. The purpose of this section is to learn how you relate to wild animals. This information will help us understand your practice choices (Questions 6 – 8). This is not a test, there are no correct or incorrect answers. ***(Please circle one response for each statement.)***

		DISAGREE				AGREE		
	STATEMENT	STRONG	MODERATE	SLIGHT	NEITHER	SLIGHT	MODERATE	STRONG
a)	Humans should manage fish and wildlife populations so that humans benefit.	1	2	3	4	5	6	7
b)	Animals should have rights similar to the rights of humans.	1	2	3	4	5	6	7
c)	I view all living things as part of one big family.	1	2	3	4	5	6	7
d)	Hunting does not respect the lives of animals.	1	2	3	4	5	6	7
e)	I feel a strong emotional bond with animals.	1	2	3	4	5	6	7
f)	The needs of humans should take priority over fish and wildlife protection.	1	2	3	4	5	6	7
g)	I care about animals as much as I do other people.	1	2	3	4	5	6	7
h)	Fish and wildlife are on earth primarily for people to use.	1	2	3	4	5	6	7
i)	Hunting is cruel and inhumane to animals.	1	2	3	4	5	6	7
j)	We should strive for a world where humans and fish and wildlife can live side by side without fear.	1	2	3	4	5	6	7
k)	I value the sense of companionship I receive from animals.	1	2	3	4	5	6	7
l)	Wildlife are like my family and I want to protect them.	1	2	3	4	5	6	7
m)	People who want to hunt should be provided the opportunity to do so.	1	2	3	4	5	6	7

SOME INFORMATION ABOUT YOURSELF

21. What is your age? _____ years

22. What is your gender? ☐ Male ☐ Female

23. In which county do you live? _____

24. Do you consider yourself a hunter? ☐ No ☐ Yes

If Yes ... How important is hunting compared to all your other recreation activities? ***(Please check one box.)***

☐ Not Important ☐ Slightly Important ☐ Moderately Important ☐ Very Important ☐ Most Important

If Yes ... Last year (2015), about how many days did you hunt, fish, and trap on the land you own/operate? ***If you did not hunt, fish, or trap on your land last year, please write "0".***

[_____] Days

If you have any additional thoughts or comments you would like to share, please use the space below.

_____

_____

_____

_____

_____

Please fold survey, place inside the self-addressed envelope, no postage necessary, and place in the mail. Thank you for your participation.

SOUTH DAKOTA STATE UNIVERSITY
Department of Natural Resource Management
Box 2014B
Brookings, SD 57007

3. Cover Letter and Questionnaire for South Dakota

South Dakota Private Landowner Opinions about Land Use & Wildlife

(Date)

Dear South Dakota Landowner,

I am writing to ask for your help with a survey of private landowners in South Dakota. Last month I sent you the included survey. I'm resending now in hopes that you will reconsider participating in this important study. I know that South Dakota landowners have a rich history of land stewardship but until now that has largely gone undocumented. The purpose of this survey is to learn what it is like to be a landowner in South Dakota and to document your opinions about land use and wildlife.

This survey aims to improve the understanding of three main aspects of landowners in South Dakota: who you are, what you do, and how your relationships with the land and wildlife affect your decisions. State agency officials will be able to use this information to evaluate private landowner conservation programs. I expect the results of this survey to reveal a connection between agriculture and conservation.

This survey is part of a larger research study focused on land use in the Northern Plains and Prairie Pothole region of Iowa, Minnesota, South Dakota, North Dakota, and Montana. Researchers and natural resource managers in these states helped design the survey questions. Surveys are being sent to randomly selected landowners in each of these states. I will summarize the data to look for trends within each state and across the region, and write the final reports.

I estimate this survey will take about 30 minutes to complete. Your participation is completely voluntary (returning a blank survey will let us know that you do not wish to participate.) You may leave any question in the questionnaire blank that you do not want to answer. Your name and contact information will never, in any way, be released or associated with the reported data. Each questionnaire has an identification number that I will use to check off your name when I receive your questionnaire, to try to ensure that I do not bother you with more mailings related to this study effort. In order to protect your anonymity, please do NOT provide your name or address on the survey. In addition, there are no known risks or direct personal benefits associated with your participation in this study.

The final report will be made available to the public no later than September 30th, 2017, through the PPP-LCC website (http://www.plainsandprairiepotholeslcc.org/) and will also be available through a wide number of outlets via the many researchers and natural resource managers involved with this project. If you have any questions or concerns about this survey you can contact me by email or by writing to me at the address on the bottom of this letter. Thank you in advance for helping me with this important research and I look forward to receiving your completed survey!

Sincerely,

Lily Sweikert

Lily Sweikert, Project Coordinator
Doctoral Student
Email: Lily.Sweikert@sdstate.edu

South Dakota State University
Department of Natural Resource Management

Box 2014B
Brookings, SD 57007

South Dakota Landowner Survey

Farming, Ranching, & Wildlife Habitat (2016)

South Dakota State University
Department of Natural Resource Management
Brookings, SD 57007

1. *Please check all that apply.* Do you consider yourself a …

❑Farmer ❑Rancher ❑Neither →*if neither, skip ahead to question #7*

➔ If farmer and/or rancher, are you currently: ❑Full-time ❑Part-time ❑Retired

2. How much land do you currently own and operate/lease? *Please check [√] <u>one</u> box*	❑a) Less than 80 acres	❑e) 641 – 1,280 acres
	❑b) 81 –160 acres	❑f) 1,281 – 3,840 acres
	❑c) 161 – 320 acres	❑g) More than 3,840 acres
	❑d) 321 – 640 acres	

3. About what percent of your total household income is derived from farming/ranching?

❑None ❑1 – 25% ❑26 – 50% ❑51 – 75% ❑76 – 100%

4. How long have you, or did you, farm/ranch? *Please check [√] <u>one</u> box.*

<u>0 – 5 years</u>	<u>6 – 10 years</u>	<u>11-20 years</u>	<u>21-30 years</u>	<u>More than 30 years</u>
❑	❑	❑	❑	❑

5. On the acres (owned & leased) about what percentage were used for each of these categories last year?

Planted commodities (e.g. corn, soybeans, wheat, oats, etc.)	_____ %
Grassland, pasture, and hay	_____ %
Lands enrolled in a set-aside conservation program (e.g. CRP, WRP, etc.)	_____ %
Remaining lands (e.g. tress, bushes, wetlands, etc.)	_____ %
TOTAL	**100%**

6. On the land you own/operate, what % do you currently make land-use decisions (e.g. commodity/livestock production/participation in conservation programs) about?

❑None ❑1 – 25% ❑26 – 50% ❑51 – 75% ❑76 – 100%

Farm/Ranch Land Use Practices

7. Below are statements representing different types of farming and ranching practices. We'd like to know whether you are currently employing these practices, if you have in the past, or if you plan to in the future, on the land you own/operate. *Please check all that apply for each row.*

Practices	Done in the past? No	Done in the past? Yes	Maintain/ currently do now?	Plan to do in the future?	Does not apply
a) Conduct soil testing	❑	❑	❑	❑	❑
b) Use conservation tillage practices	❑	❑	❑	❑	❑
c) Rotate crops	❑	❑	❑	❑	❑
d) Plant cover crops	❑	❑	❑	❑	❑
e) Plant trees and shrubs (e.g. shelter belts)	❑	❑	❑	❑	❑
f) Control agricultural run-off	❑	❑	❑	❑	❑
g) Plant and maintain filter strips	❑	❑	❑	❑	❑
h) Establish or restore wetlands	❑	❑	❑	❑	❑
i) Use herbicides	❑	❑	❑	❑	❑
j) Use integrated pest management	❑	❑	❑	❑	❑
k) Use insecticide	❑	❑	❑	❑	❑
l) Use a written grazing management plan	❑	❑	❑	❑	❑
m) Provide livestock with water tanks	❑	❑	❑	❑	❑
n) Plant pollinator seed mixes	❑	❑	❑	❑	❑
o) Protect milkweed to feed monarch larvae	❑	❑	❑	❑	❑
p) Manage/maintain wetlands for wildlife	❑	❑	❑	❑	❑
q) Plant food plots	❑	❑	❑	❑	❑
r) Manage grasslands for wildlife	❑	❑	❑	❑	❑

Continued on next page

7. Farm/Ranch Land Use Practices Continued.

Practices	Done in the past? No	Done in the past? Yes	Maintain/ currently do now?	Plan to do in the future?	Does not apply
s) Use non-lethal methods (e.g. hazing, fencing) to prevent/reduce property damage	❑	❑	❑	❑	❑
t) Use lethal methods (e.g. shooting, trapping) to prevent/reduce property damage	❑	❑	❑	❑	❑
u) Allow free reasonable public hunting access	❑	❑	❑	❑	❑
v) Provide hunting access for a fee	❑	❑	❑	❑	❑

8. Please rate the importance of each of the objectives/reasons for why you might use one or more of the various land use practices above. *Please circle <u>one</u> number for each row.*

Reasons	Not a Reason	Slightly Important	Moderately Important	Very Important
a) Provide shelter for wildlife	1	2	3	4
b) Financial considerations	1	2	3	4
c) Control wildlife	1	2	3	4
d) Raise and produce livestock	1	2	3	4
e) Produce and grow agricultural crops	1	2	3	4
f) Remove/control unwanted plants	1	2	3	4
g) Prevent soil erosion	1	2	3	4
h) Increase grazing season length	1	2	3	4
i) Improve productivity	1	2	3	4
j) Provide habitat for wildlife	1	2	3	4
k) Protect fisheries	1	2	3	4
l) Produce and grow feedstock	1	2	3	4
m) Protect riparian vegetation	1	2	3	4
n) Provide water for wildlife	1	2	3	4
o) Control insects	1	2	3	4
p) Provide food for wildlife	1	2	3	4
q) Increase plant diversity	1	2	3	4
r) Protect water quality	1	2	3	4
s) Attract and feed bees & butterflies	1	2	3	4
t) Encourage quick vegetation recovery	1	2	3	4

9. Please rate how important each of these wildlife categories are to decisions you make about land use. *Please circle one number for each row.*

Wildlife categories	Not Important	Slightly Important	Moderately Important	Very Important
a. Deer, elk, antelope, etc.	1	2	3	4
b. Pheasant, grouse, etc.	1	2	3	4
c. Ducks, geese, shorebirds, etc.	1	2	3	4
d. Coyotes, foxes, mountain lions, etc.	1	2	3	4
e. Other non-game mammals	1	2	3	4
f. Hawks, eagles, owls, etc.	1	2	3	4
g. Songbirds	1	2	3	4
h. Fish	1	2	3	4
i. Reptiles & amphibians	1	2	3	4
j. Bees	1	2	3	4
k. Monarchs and other butterflies	1	2	3	4
l. Other insects	1	2	3	4

10. On the land you own/operate, in the past 10 years (2005 – 2015), did you convert any pasture or other grasslands to crops? *Please check [√] <u>one</u> box.* ❑ No ❑ Yes

➔ *If Yes, please check [√] all types of pasture or grassland converted*:

<u>Virgin/ Native Pasture or Grassland</u>	<u>Planted Grassland (e.g. CRP)</u>
❑	❑

11. On the land you own/operate, in the past 10 years (2005 – 2015), did you drain, move, or minimize any wet areas on your land? *Please check [√] <u>one</u> box.* ❑ No ❑ Yes

12. We're interested in knowing your perceptions of change in the natural conditions on and around your land, over the past 30 years. *For each condition below please circle <u>one</u> response.*

Natural Condition	Decreased	No Change	Increased	No Opinion
a) **Soil quality**	1	2	3	4
b) **Water quality**	1	2	3	4
c) **Vegetation/forage quality**	1	2	3	4
d) **Farm/ranch productivity**	1	2	3	4
e) **Wildlife habitat quality**	1	2	3	4
f) **Presence of wildlife/game**	1	2	3	4

USDA Farm Bill Conservation Programs

The Farm Bill is a compilation of several pieces of federal legislation, which governs agriculture and conservation programs intended to enhance agricultural productivity and conservation on private lands. We are interested in learning about any experience you may have had with the USDA Conservation Programs contained within the Farm Bill.

13. Have you enrolled any of your land in a USDA Farm Bill Conservation Program (e.g., CRP, WRP, EQIP, CSP, etc.) in the past 30 years? *Please check [√] one box.* ❑No ❑Yes

14. Please indicate the importance of each of the following reasons for why you do *not* or no longer participate in a Farm Bill Conservation Program (**Skip this section if it does not apply to you).** *Please circle one number for each row.*

Reasons for Not participating in a Farm Bill Conservation Program	Not a Reason	Slightly Important	Moderately Important	Very Important
a) Do not want to sign a contract with the government	1	2	3	4
b) Decreases my options for using my property	1	2	3	4
c) Increases my expenses	1	2	3	4
d) Do not want to work with a conservation partner (e.g Ducks Unlimited) to enroll my land	1	2	3	4
e) Takes a lot of time and effort	1	2	3	4
f) The financial incentives are not high enough	1	2	3	4
g) I don't have any land that qualifies	1	2	3	4
h) The programs are too complicated and confusing	1	2	3	4
i) The length of the agreement (in years) is too long	1	2	3	4
j) There are not enough enrollment opportunities	1	2	3	4

15. Please indicate the importance of each of the following reasons for your participation in a Farm Bill Conservation Program (**Skip this section if it does not apply to you).** *Please circle one number for each statement.*

Reasons For participating in a Farm Bill Conservation Program	Not a Reason	Slightly Important	Moderately Important	Very Important
a) Improve soil quality	1	2	3	4
b) Improve habitat for game species	1	2	3	4
c) Protect endangered species	1	2	3	4
d) Tax credits/benefits	1	2	3	4
e) Provide habitat for monarch butterflies	1	2	3	4

Continued on next page

15. Continued.

Reasons <u>For</u> participating in a Farm Bill Conservation Program	Not a Reason	Slightly Important	Moderately Important	Very Important
f) Financial compensation	1	2	3	4
g) Improve habitat for non-game wildlife	1	2	3	4
h) Improve water quality	1	2	3	4
i) Support native grass plantings	1	2	3	4
j) Provide habitat for pollinators	1	2	3	4
k) Provide habitat buffers for upland birds	1	2	3	4
l) Provide shallow water (wet) areas	1	2	3	4
m) Provide river/stream buffer strips	1	2	3	4
n) Increase plant diversity	1	2	3	4

<u>State Conservation Programs</u>

Several South Dakota state agencies and nonprofit organizations have developed conservation programs for private landowners to conserve grassland habitat, plant shrubs and trees, restore wetlands, and providing hunting access.

16. Have you participated in a cost-share program for any of the following reasons?
Please check [√] No or Yes for each row.
→ *If No, please check [√] No or Yes if you are likely do so in the future.*

Reasons for Participating	Did you Participate?		If No, are you likely to do so in the future?	
	No	Yes	No	Yes
a. Food plots	❑	❑	❑	❑
b. Woody habitat (shelterbelt) establishment	❑	❑	❑	❑
c. Habitat exclusion fencing	❑	❑	❑	❑
d. Nesting cover establishment	❑	❑	❑	❑
e. Grass establishment for managed grazing	❑	❑	❑	❑
f. Cross fencing for managed grazing	❑	❑	❑	❑
g. Stock water development for managed grazing	❑	❑	❑	❑
h. Multi-purpose pond/wetland establishment	❑	❑	❑	❑
i. Wetland Restoration	❑	❑	❑	❑
j. River/streamside pasture management	❑	❑	❑	❑
k. Wildlife friendly fence	❑	❑	❑	❑

Future Plans:

According to the USDA's 2012 Census of Agriculture, 68% of farmers are over the age of 55, and only 0.6% are under the age of 25. These facts raise concerns about the future of farming and ranching lifestyles and legacies. We'd like to ask you about your plans for your land to see if conservation programs could help protect farming and ranching livelihoods and legacies.

17. Are you planning on changing the size of your operation in the next 10 years? *Please check [√] one box.*

Decrease	No Change	Increase	No Opinion
❑	❑	❑	❑

18. What do you think is the possibility of the following options for the land you own/operate when you retire or are no longer able to run the farm/ranch? *Please circle one response for each statement.*

Future Options for your Land	Possibility of Option Happening				Does not Apply
	None	Slight	Moderate	Strong	
a) Sell all of the land, at one time, to a willing buyer	1	2	3	4	5
b) Sell off parts of the land and reduce the amount of the land owned	1	2	3	4	5
c) Let my family inherit the land and develop their own operation methods	1	2	3	4	5
d) Pass the land and methods of operation to my family	1	2	3	4	5
e) Sell all of the land to a person or organization that will continue the same operations	1	2	3	4	5
f) Sell/donate the land to an organization that will protect the land from development	1	2	3	4	5
g) Enroll the land in a conservation program that prevents development	1	2	3	4	5

19. Would you be interested in a conservation program that would allow your family to continue your current farming/ranching operations? *Please check [√] one box.*

❑No ❑Yes

Land Use Relations

20. Below are 15 statements representing different ways people think about land use. The purpose of this section is to learn how **you** relate to the land and to help us understand your land use practice choices (Questions 7-9). This is not a test, there are no correct or wrong answers. *Please circle one response for each statement.*

	Disagree			Neither	Agree		
Statement	Strong	Moderate	Slight		Slight	Moderate	Strong
a) The diversity of plants and wildlife in an area is a sign of the quality of the natural environment.	1	2	3	4	5	6	7
b) Because farmers' and ranchers' livelihoods depend on the land, they are the best stewards of the land.	1	2	3	4	5	6	7
c) Farmers and ranchers have an obligation to protect the soil, water, plants, habitat, and fish and wildlife on their land.	1	2	3	4	5	6	7
d) The best use of land should be determined by the amount of profit that can be earned annually.	1	2	3	4	5	6	7
e) Large-scale restoration, across the landscape, is required to improve the condition of the land.	1	2	3	4	5	6	7
f) Farmers/ranchers should focus on optimizing production on their farm/ranch regardless of environmental costs.	1	2	3	4	5	6	7
g) Farmers and ranchers have the right to use the soil, water, plants, and animals on their land in any way they see fit.	1	2	3	4	5	6	7
h) All parts of the ecosystem, down to the microorganisms in the soil, are important for proper functioning of the landscape.	1	2	3	4	5	6	7
i) If you take care of the land, it will take care of you	1	2	3	4	5	6	7
j) Restored lands maximize both productivity and ecosystem function.	1	2	3	4	5	6	7

Continued on the next page.

20. Land Use Relations Continued.

Statement	Disagree			Neither	Agree		
	Strong	Moderate	Slight		Slight	Moderate	Strong
k) The quality of the land is positively influenced by the diversity of native plants and animals that live on or around it.	1	2	3	4	5	6	7
l) The needs of farmers and ranchers should take priority over the conservation of land.	1	2	3	4	5	6	7
m) Farmers and ranchers are masters of the land.	1	2	3	4	5	6	7
n) We should restore the landscape to the way it was when the pioneers first arrived.	1	2	3	4	5	6	7
o) Farmers and ranchers are only temporary trustees of the land and it is their responsibility to take good care of it for future generations.	1	2	3	4	5	6	7

Fish and Wildlife Values

21. Below are 13 statements representing different ways people value wildlife. The purpose of this section is to learn how **you** relate to wild animals. This information will help us understand your practice choices (Question 7-9). This is not a test, there are no right or wrong answers. *Please circle one response for each statement.*

Statement	Disagree			Neither	Agree		
	Strong	Moderate	Slight		Slight	Moderate	Strong
a) Humans should manage fish and wildlife populations so that humans benefit.	1	2	3	4	5	6	7
b) Animals should have rights similar to the rights of humans.	1	2	3	4	5	6	7
c) I view all living things as part of one big family.	1	2	3	4	5	6	7
d) Hunting does not respect the lives of animals.	1	2	3	4	5	6	7

Continued on the next page.

21. Fish and Wildlife Values Continued.

Statement	Disagree			Neither	Agree		
	Strong	Moderate	Slight		Slight	Moderate	Strong
e) I feel a strong emotional bond with animals.	1	2	3	4	5	6	7
f) The needs of humans should take priority over fish and wildlife protection	1	2	3	4	5	6	7
g) I care about animals as much as I do other people.	1	2	3	4	5	6	7
h) Fish and wildlife are on earth primarily for people to use.	1	2	3	4	5	6	7
i) Hunting is cruel and inhumane to the animals.	1	2	3	4	5	6	7
j) We should strive for a world where humans and fish and wildlife can live side by side without fear.	1	2	3	4	5	6	7
k) I value the sense of companionship I receive from animals.	1	2	3	4	5	6	7
l) Wildlife are like my family and I want to protect them.	1	2	3	4	5	6	7
m) People who want to hunt should be provided the opportunity to do so.	1	2	3	4	5	6	7

Some Information about Yourself

22. Do you consider yourself a hunter? ❑No ❑Yes

➔ If Yes…

a) How important is hunting compared to all your other types of recreation?

❑1) Not Important
❑2) Slightly Important
❑3) Moderately Important
❑4) Very Important (but **not** the most important)
❑5) My **MOST** Important Recreational Activity

b) On the land you own/operate, about how many days did you hunt last year (2015) (include all types of hunting)? *If you did not hunt on your land last year, please write "0".*

[_____] Days

23. In which South Dakota county do you live? _____ county

24. What is your age? _____ years

25. What is your gender? ❑Male ❑Female

THANK YOU FOR YOUR PARTICIPATION!

You may use this space for Optional Comments:

South Dakota State University
Department of Natural Resource Management
Brookings, SD 57007

To return your questionnaire, fold it in half and return it using the addressed, pre-paid return envelope provided.

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